# PROCEEDINGS

of the

# 43rd ANNUAL

# WESTERN FOREST INSECT

# WORK CONFERENCE

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**PENTICTON, BRITISH COLUMBIA**

**MARCH 2 - 5, 1992**

# PROCEEDINGS

# FORTY-THIRD ANNUAL

# WESTERN FOREST INSECT

# WORK CONFERENCE

**PENTICTON, BRITISH COLUMBIA**

**MARCH 2 - 5, 1992**

Not for Citation
(For Information of Conference Members Only)

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Pacific Forestry Centre
Forestry Canada

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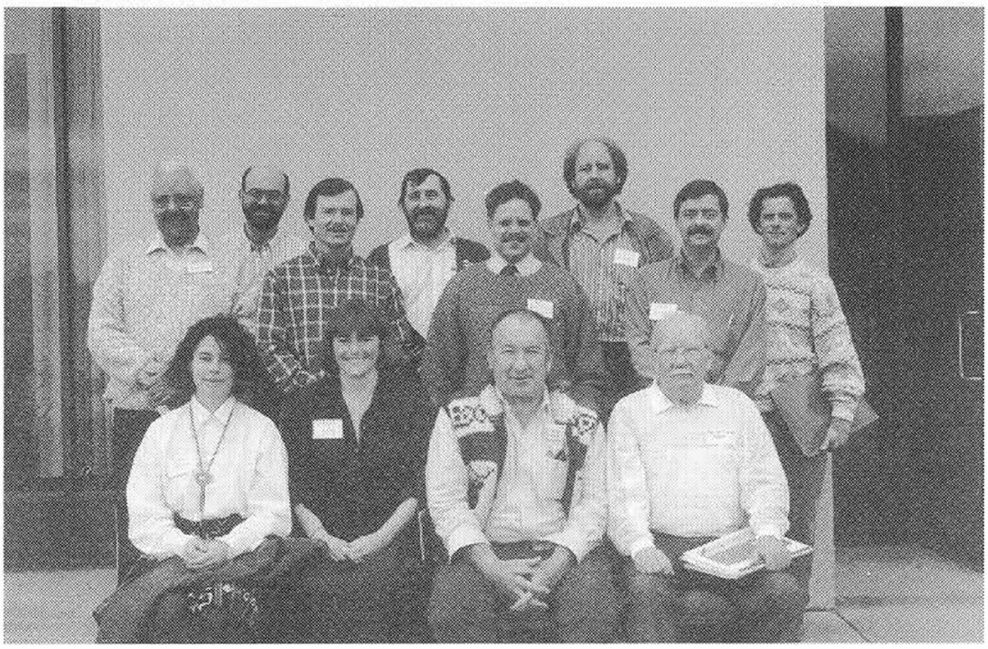
Victoria, British Columbia

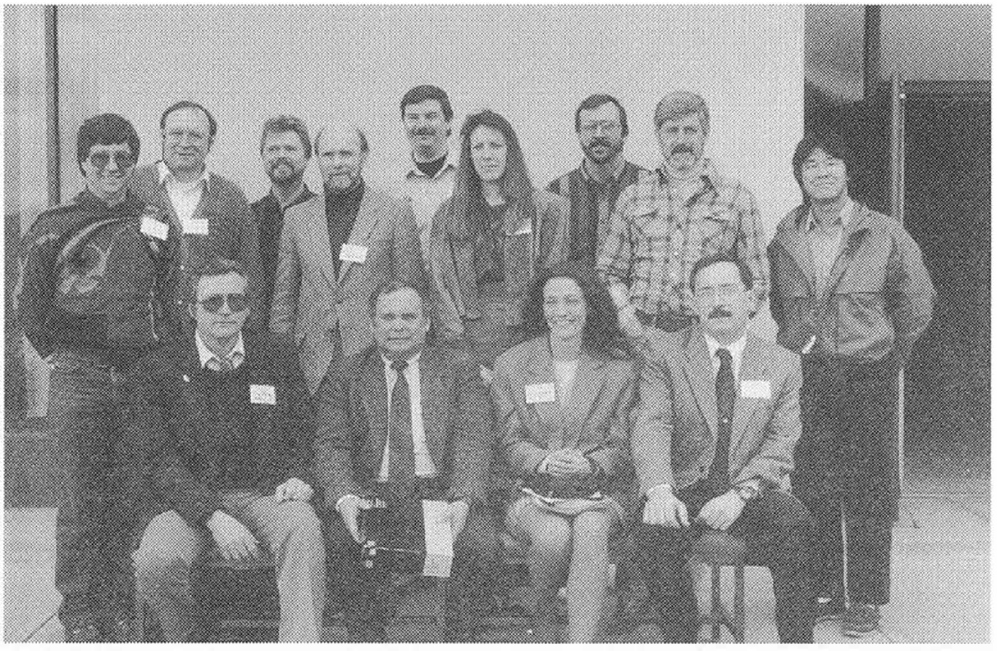
**Front Row:** Steve Kohler, Roger Sandquist, Jesse Rios, Susan Senger
**Middle Row:** Lonne Sower, Beth Willhite, Andy Eglitis, Mal Furniss
**Back Row:** Don Wright, Jerry Lenhard, Mike Wagner, Evan Nebeker, Bruce Hostetler, Gary Petersen

**Front Row:** John Wenz, Chris Niwa, Ed Holsten, Ladd Livingston, Jill Wilson
**Middle Row:** Pete Lorio, Felton Hastings, John Borden, Therese Poland, Elizabeth Tomlin, Leslie Chong, Lisa Poirier
**Back Row:** Eric Haupt, Brent Olsen, David Piggin, Fred Hain, Dave Bridgwater, Alejandro Camacho



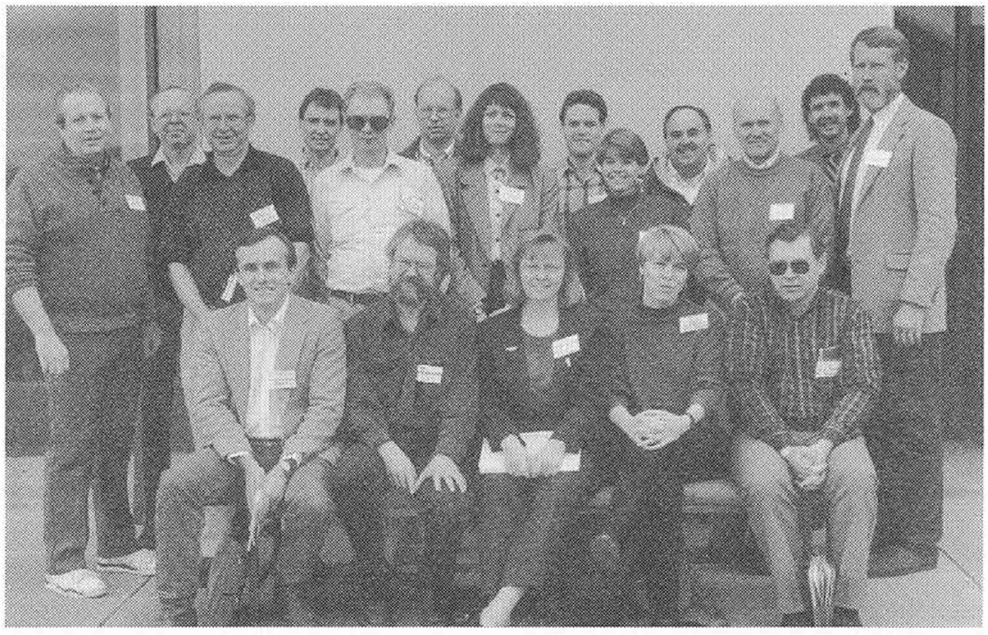
**Front Row:** Julie Brooks, Joan Holt, J.M. Schmid, Red McComb
**Middle Row:** Norm Alexander, Don Owen, William Antrobius, Don Summers
**Back Row:** Dan Miller, Gyula Kiss, Jerry Carlson, Kees Van Frankenhuyzen

**Front Row:** Dave Schultz, Mike Hulme, Leo Rankin, Rich Goyer
**Middle Row:** Marc Linit, John Spence, Allan Van Sickle, Gordon Miller, Tom Payne
**Back Row:** Michael Valenti, John Harris, Leroy Kline, Scott Salom, Darrell Ross



**Front Row**: Jim Byler, Jan Volney, Iral Ragenovich, Lee Humble
**Middle Row**: Emile Begin, Les Safranyik, Gene Amman, Lorraine Maclauchlan, Alan Berryman, Tim Ebata
**Back Row**: Terry Shore, Mike Valenti, Bob Cain

**Front Row**: Gerhard Gries, Joseph Liebl, Lynn Wyatt, Sandy Gast, Regine Gries
**Middle Row**: Brian Sieben, Kornelia Lewis, Imre Otvos, Gerry Fraser, Aileen Wardle
**Back Row**: Rory McIntosh, John McLean, Jim Weber, Brad White, Dave Braun



**Front Row:** Roger Burnside, Keith Reynolds, Sally Bertram, Nancy Rappaport, Larry Stipe
**Middle Row:** Tim Paine, Hal Wieser, Jane Carter, Barb Bentz, Robert Wolfe, Jed Dewey, John Stein
**Back Row:** Dayle Bennet, Bernie Raimo, Ed Senger, Tom Lacey, Pat Byrne, John Dale

**Front Row:** Eric Smith, Julie Weatherby, Ken Wright, Sheri Smith, Skeeter Werner
**Middle Row:** T. Torgersen, Jorge Macias, Chris Hanlon, Dick Schmitz, Ron Billings, Steve Munson, William Upton
**Back Row:** Bob Backman, Don Heppner, Robert Hodgkinson, Lloyd Vandermark, Mark Hamm, Ken Gibson

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**FINAL PROGRAM**

**43rd Annual Western Forest Insect Work Conference**

March 2 - 5, 1992

Penticton, British Columbia

**Monday, March 2**

**18:00 - 20:00** Registration at Lakeside Resort

**19:30 - 21:30** Wine and Cheese Social, Penticton Art Gallery

**Tuesday, March 3**

**08:00 - 10:00** Registration

**08:30 - 10:00** Business Meeting

**10:30 - 12:00** Panel

**Future Shock: an Examination of Potential Impacts of a Changing Society and a Changing Environment on Forest Health Issues.**

Moderator - **Dr. J. Borden**, Simon Fraser University

- Old Growth Management - **Warren Mitchell**, BC Forest Service
- Pesticides - **Dr. Ron Kobylnyk**, BC Ministry of Environment
- New Forestry - **Norm Alexander**, BC Institute of Technology
- Global Climate Change - **Dr. J. Borden**, Simon Fraser University

**12:00 - 13:30** Lunch

**13:30 - 15:00** Workshop Session 1

- Competitive Interactions Between Primary and Secondary Bark Beetles - **D. Miller**, Phero Tech Inc., Vancouver
- Forest Health Input into IRM Planning - **L. Kline**, Oregon Dept. of Forestry
- Use of Models - **N. Crookston**, USFS, Moscow
- Regional Pest Updates - **L. Livingston**, Idaho Dept. of Lands
- Hazard and Risk Rating for Forest Insects - **T. Shore**, Forestry Canada, Victoria

**Tuesday, March 3**

**15:30 - 17:00** Workshop Session 2

- Host Location by Bark Beetles - **D. Miller**, Phero Tech Inc., Vancouver
- Second Growth Pests - **T. Ebata**, BC. Forest Service, Smithers
- Insect Population Dynamics and Selection of Pest Management Strategy - **L. Safranyik**, Forestry Canada, Victoria
- Male Disruption Techniques in Lepidoptera - **C. Niwa**, USFS, Corvallis
- B.t. - Applications and Opportunities - **K. Van Frankenhuyzen**, Forestry Canada, Sault Ste. Marie

**19:00 - 21:00** Evening Session

- Poster Session
- Modeling Demonstrations

**Wednesday, March 4**

**08:30 - 10:00** Workshop Session 3

- Defoliator Management Strategies - **J. Wenz**, USFS, Sonora
- Incorporation of Loss Data into Timber Supply Analysis - **G. Fraser**, Canadian Pacific Forest Products, Victoria
- Weevils - **L. Maclauchlan**, BC. Forest Service, Kamloops
- Technology Transfer - **J.W.E. Harris**, Forestry Canada, Victoria
- Forest Health/Quarantine Issues - **L. Humble**, Forestry Canada, Victoria

**10:30 - 12:00** Workshop session 4

- Historical Records Versus Climate Change - **J. Volney**, Forestry Canada, Edmonton
- Use of Antiaggregants for Bark Beetles - **S. Werner**, USFS, Fairbanks
- Gypsy Moth: Suppression or Eradication - **A. Van Sickle**, Forestry Canada, Victoria
- Survey and Detection Techniques - **Ken Gibson,** USFS, Missoula
- Forest Health and Non-Timber Values - **J. Dale**, USFS, San Francisco

**12:00 - 13:30** Lunch and Group Photos

**Wednesday, March 4**

**13:30 - 15:00** Panel

**Biodiversity/Sustainable Ecosystems**

Moderator - **I. Ragenovich**, USFS, Portland

- Some Philosphies on Ecosystems - **T. Aztet,** USFS, Siskyou National Forest
- Relationships of Pests to other Ecosystem Disturbances - **A. Harvey,** USFS, Intermountain Forest & Range Exp. Stn.
- Ecosystem Sustainability and Planning - **J. Byler,** USFS Forest Pest Management, Northern Region

**15:30 - 17:00** Workshop Session 5

- Scolytid Strategies - **D. Miller**, Phero Tech Inc., Vancouver
- Damage Appraisal - **R. Alfaro**, Forestry Canada, Victoria
- Cone and Seed Insects - **D. Summers**, BC Forest Service, Victoria
- Biocontrol Presentations - Getting the Message Across with Video - **M. Hulme**, Forestry Canada, Victoria
- Need For and Coordination of Demonstration Areas - **K. Gibson**, USFS, Missoula

**19:00 - 21:00** Evening Session

**Asian Strain of Gypsy Moth: Concerns and Discussion**

**P. M. Hall**, B.C.Forest Service, Victoria

**Thursday, March 5**

**08:30 - 10:00** Business Meeting

**10:30 - 12:00** Workshop Session 6

- Mountain Pine Beetle Management - **P. M. Hall**, B.C.Forest Service, Victoria
- Host Location by Parasites and Predators - **F. Stephens**, University of Arkansas, Fayetteville
- Future Research Priorities - **G. Miller**, Forestry Canada, Victoria
- Douglas-fir Tussock Moth Management - **I. Ragenovich**, USFS, Portland
- Expert Systems/Decision Aids - **B. Benz**, USFS, Logan

**12:00 - 13:30** Lunch (included in registration)
**Thursday, March 5**

**13:30 - 15:00** Workshop 7

- Isolation and Identification of Semiochemicals - **G. Griese**, Simon Fraser University, Burnaby
- Stand Structures Post Outbreak - **R. Shepherd**, Victoria, BC.
- Public Interaction and Participation - **M. Geisler**, BC. Forest Service, Hazelton
- History of Forest Entomology in the West - **M. Furniss**

**15:00** FINISH

Conference Chairman - T.L. Shore, Forestry Canada

Program Committee - P.M. Hall, BC. Ministry of Forests
- L. Safranyik, Forestry Canada
- D. Miller, Phero Tech Inc.
- L. Humble, Forestry Canada (Local Arrangements)

**WESTERN FOREST INSECT WORK CONFERENCE**
**43RD ANNUAL MEETING**
**PENTICTON, BRITISH COLUMBIA**

**EXECUTIVE COMMITTEE MEETING**
**5:30 p.m. MARCH 2, 1992**

Present:

Terry Shore, Chairperson
Ladd Livingston, Treasurer
Jill Wilson, Secretary
John Wenz, Past Chairperson
Bernie Raimo, Counselor
Torgy Torgersen, Common Names Committee Chairperson
Hohn Schmid, Founders Award Committee Chairperson
Mal Furniss, History Committee, Chairperson

Chairperson Shore called the meeting to order at 5:30 PM

1) Tributes to retired members: Dick Schmits, Bruce Roettgering, Roy Shepherd, Henry Moeck

2) Minutes of the 1991 Final Business Meeting

The minutes of the 1991 Final Business Meeting were reviewed. No errors or omissions were reported, and the minutes were accepted.

3) Future Meetings

a) 1993 - March 1 through March 4, in Sacramento, California. Program Committee: Don Dahlsten and Dave Wood

b) 1994 - To be determined

4) Committee Reports:

a) Treasurer's Report

Treasurer Ladd Livingston presented a summary of the work conference's financial activities during the past year. In brief, the balance on hand prior to the 1991 meeting was $6,231.94, and the balance prior to the current (1992) meeting is $4,180.51.

Terry Shore and John Wenz audited the Treasurer's Report and approved it. The Executive Committee voted unanimously to accept the Treasurer's Report.

b) Awards Committee

Chair Schmid announced that the recipient of the Founders Award had been selected.

Criteria for McGregor Award were presented (see notes). During discussion of the proposal several questions were raised:

If this is basically a PheroTech award, why don't they administer it? It will take a long time to get $15,000. Is PheroTech still interested in this proposal? Should we table this proposal if no PheroTech representative is present (Staffan Lindgren was unable to attend this meeting)?

It was moved that the proposal be posted during the meetings and brought up for discussion during the final business meeting. This motion was seconded and approved.

c) History Committee

Mal Furniss read the History Committee report (see First Business Meeting Committee Minutes).

d) Common Names Committee

Torgy Torgersen read the common names committee report (see First Business Committee Minutes).

e) Nominating Committee

John Wenz, Les Safranyik, and Jill Wilson were appointed to nominating committee. Current vacancies include:

Chairperson: 2 year term
Counselor: 3 year term

5) New Business

a) Permanent Logo?

Terry mentioned proposal to adopt the piece of artwork being used as the '92 logo as a permanent WFIWC logo. Executive Committee agreed to introduce the idea at the first business meeting and vote on the proposal at the Thursday business meeting.

b) Free Rooms:

Two free rooms are available. Terry proposed that these rooms be used for retired individuals here out of pocket. There were no objections to this proposal, the Executive Committee agreed that this proposal should be brought up at the First Business Meeting

The meeting was adjourned at 7:30.

**WESTERN FOREST INSECT WORK CONFERENCE**

**43RD ANNUAL MEETING**
**PENTICTON, BRITISH COLUMBIA**

**FIRST BUSINESS MEETING**
**March 3, 1992**

Chairperson Terry Shore called the meeting to order.

1) Tributes to retired members (see executive meeting minutes)

2) Minutes of the Final 1991 Business Meeting and the Executive Committee were read and approved.

3) Treasurers Report

Ladd Livingston read the Treasurers Report. The balance on hand prior to the 1991 meeting was $6,231.94. The ending balance prior to this meeting was $4,180.51

4) Future Meetings

1993 - Sacramento, California, March 1 through March 4. The program committee for these meetings will include Don Dahlsten and Dave Wood.

1994 - Chairperson Shore mentioned the offer of the Western International Forest Disease Work Conference to hold their meeting concurrently with WFIWC either in 1994 or 1995 at the location and timing of our choosing. It was proposed that this meeting occur in 1994. Invitations were solicited for the location of this meeting.

5) Committee Reports

a) Founders Award Committee

John Schmid announced that Dave Wood will be this years recipient of the Founders Award.

Discussion Followed. Could the first call for nominations be sent out with the first meeting announcement? A proposal was made that the recipient give a speech at the meeting in the year he or she is selected. This Motion was seconded and accepted by the group.

John Schmid also mentioned that he wished to step down as chairperson for this committee.

b) Permanent Mailing List

Ladd Livingston mentioned that two copies of the current mailing list are available on the registration table. Active members will be those who have attended one meeting in the previous 5 years. Provision will also be made for individuals who would like to remain on the active list but who cannot attend meetings as frequently.

c) Common Names Committee

Chairperson Torgersen submitted this report.

Committee members as of February 27, 1992 include Lee Humble, Robert Lavigne, Judith Pasek, Iral Ragenovich, John Stein, Larry Stipe, and chairperson Torolf Torgersen

Membership Changes - Changes since last year include the resignations of Charles Sartwell and Robert Stevens. A slate of candidates to replace the seats vacated by Sartwell and Stevens was submitted to Chairperson Terry Shore. As called for in the by-laws, Shore chose Robert Lavigne and John Stein to fill the vacancies.

Actions - This year one application for consideration of a new common name was submitted by Malcolm Furniss. He proposes the name "boreal spruce beetle" for *Dendroctonus punctatus.*

d) History Committee

Chairperson Furniss submitted this report

Members: Mal Furniss, Ron Stark

Purpose: Preserve, promote, publicize history of western forest entomology.

Time span: From the beginning of the field, 1899 when A.D. Hopkins first came west. The Univ. of Idaho Special collections are the official archives.

Torgy Torgersen, La Grande, Oregon, reports that he insect collection, began at the Portland Forest insect lab in the 1930's has been moved to the Corvallis Forestry Sciences Lab. Consolidated with it are collections form Berkeley and Coeur d'Alene. The specimens are presently in storage, awaiting allocation of space and commencement of curatorial operations

under contract with the Oregon State University Department of Entomology.
Boyd Wickman is awaiting publication this spring of his historical account of past outbreaks in relation to the adverse "forest health" situation in the Blue Mountains. He has made effective use of reports of the old Bureau of Entomology to provide perspectives on current (and future) problems. A recent example is his publication, Mammoth Lakes Revisited - 56 years After a Douglas-fir Tussock Moth Outbreak. PNW-RN-498 (1990). It documents increased radial growth on defoliated white fir that survived. In May, he will talk at the 90th anniversary of Crater Lake N.P. on "Battling Bark Beetles in Crater L.N. P."

Through the interest and financial support provided by Chairperson Terry Shore and the Executive Officers, the 2800 pages of correspondence between A.D. Hopkins and Josef Brunner (1909-1917) were copied onto microfiche. A copy was deposited in the University of Idaho Special Collections Library.

Using Microfiche, M. Furniss prepared a manuscript, "Birth of Forest Entomology in Montana" that will be submitted to a history journal. The unedited draft will be deposited with the microfiche.

The old Berkeley Forest Insect Lab photo file, dating from the employment of H.E. Burke, J.M. Miller, R.P. Keen, J.M. Patterson and others in the Bureau of Entomology, is a major historical resource. Changes in organization and other circumstances make it a timely subject to be discussed by Nancy Rappaport and others at the forthcoming History Workshop. The intent is to consider means of cataloging the photos for access by users, and preservation of the photos. An advisory committee representing the interested individuals and organizations will be appointed to that end.

5) Other Business

a) Western Forest Insects

Chairperson Shore announced that we are awaiting Bob Bridges report on the need for revising vs. reprinting and revising this publication.

b) MacGregor Award

Chairperson Shore announced that the rules for administering the award and the selection criteria for selecting the winner would be on the registration

board for viewing. Pherotech is willing to put in $2000 of seed money, but is looking for more contributions to bring the amount up to $7500. A vote will be taken during the final business meeting.

c) North American Forest Insect Work Conference Proceedings

Skeeter Werner announced that these have been published and should be sent out to participants shortly.

d) Resolutions

John Borden asked if the group would want to consider taking positions on foreign log importations and Asian gypsy moth. He agreed to appoint an ad hoc committee (Leroy Kline and Alan VanSickle) to propose two draft resolutions on these issues.

**WESTERN FOREST INSECT WORK CONFERENCE**

**43RD ANNUAL MEETING**
**PENTICTON, BRITISH COLUMBIA**

**FINAL BUSINESS MEETING**
**March 5, 1992**

Chairperson Shore called the meeting to order.

1) Minutes of the first Business meeting were read and approved.

2) Resolutions:

a) Foreign Timber Importations

The following resolution foreign timber importations into Western North America was read by John Borden and approved by the group.

Whereas the Western Forest Insect Work Conference is an international body of scientists and forest health professionals representing Canada, the U.S.A. and Mexico, and

Whereas Several trial importations of unseasoned raw logs from foreign countries (notably Eastern Siberia and New Zealand into the western United States have occurred in 1991, and

Whereas the logs imported in 1991 have been shown to harbour quarantinable pests, and there is a continual threat of introduction of new forest pests into North America on or in such timber, and

Whereas concerns raised in the past year by various scientific and professional organizations about the threat of introduction of foreign pests on unseasoned timber have not diminished, and

Whereas methods of mitigating potential pest organisms on imported timber have been proposed, but have not yet been demonstrated to be effective, and have not been incorporated into policy,

Be it resolved that the Western Forest Insect Work Conference advise all governments concerned with foreign timber importations to formulate and implement rational policy that will ensure through proven methods of mitigation the exclusion of potential pest organisms

on foreign timber, and not to permit foreign timber importations until such assurance is possible, and

Be it further resolved that the chairman of the Western Forest Insect Work Conference transmit the above resolution in writing to the U.S. Secretary of Agriculture, the Canadian Ministers of Agriculture and Forestry the Mexican Secretary of Agriculture and the Governor and Premier of the States and Provinces concerned, with copies to other relevant officials at the State, Provincial and Federal levels.

b) Eradication of Asian Gypsy Moth

John Borden submitted a resolution regarding eradication of Asian gypsy moth. The following is the final resolution which was approved by the group, with 3 opposing.

Whereas the Western Forest Insect Work Conference is an international body of scientists and forest health professional, representing Canada, the U.S.A. and Mexico, and

Whereas the Asian gypsy moth was detected in 1991 in British Columbia, Washington and Oregon, and

Whereas the Asian gypsy moth could become a very severe pest in North America, as evidenced by current severe outbreaks in Siberia, and as embodied by characteristics not found in European Gypsy Moth, i.e. the capability of females to fly, and a larval host range that embraces conifers as preferred host species, and

Whereas the threat of transporting egg masses from infested zones in North America on all cargo bound for on-or-off-shore export markets will result in crippling quarantine restrictions, and very costly measures of sanitation and certification of pest-free status, and

Be it resolved that the Western Forest Insect Work Conference advises all governments concerned to ensure that timely and aggressive eradication procedures be implemented in 1992 in such a way that the chances of successful eradication are maximized and

Be it resolved that the concerned governments are also advised to continue to monitor intensively for Asian gypsy moths in the future, to intercept carriers of Asian gypsy moths, and to make a commitment to

eradicate introduced populations of the moth whenever and wherever they are found.

Be it further resolved that the Chairman of the Western Forest Insect Work Conference transmit the above resolution in writing to the U.S. secretary of agriculture, the Canadian Ministry of Forestry and Agriculture, and the Governors and Premier of the States and Province concerned, with copies to other relevant elected officials at the State, Provincial and Federal levels.

3) Logo

Terry Shore brought up the proposal to accept the 92 logo as the permanent logo for WFIWC

Much discussion ensued: are we accepting the color, form and shape? Should we be using native art imitations? To this question it was proposed that we have a native American interpret this piece. Should we select this logo even though it is not representative of the whole region? Should we adopt only one logo, why not different ones for each work conference? Ladd Livingston, Treasurer, commented that this would be very expensive. Other comments included: 1) since the founders of the group were from the NW this logo is appropriate. 2) provide opportunity for other logo ideas 3) Logo doesn't have to represent the whole region. 4) appoint a committee to look into this issue.

It was moved that we think about this for another year before voting. This motion was seconded and approved.

4) Roger Sandquist proposed a resolution regarding the insect collections to be housed at the Corvallis lab of PNW. Much discussion ensued on this topic. Chris Niwa agreed to check on the status of the collections, which one will be there, where they will be, who will maintain them and how other people can use them and report on this next year. A decision could be made at that time as to whether or not we need a resolution.

5) Bernie Raimo proposed the following resolution to thank the organizers of the 1992 Western Forest Insect Work Conference for their excellent work in organizing this excellent conference.

Be it resolved that the membership recognizes and expresses its appreciation to the organizers and hosts of the 43rd annual meeting of the Western Forest Insect Work Conference. Through their hard work and hospitality,

they have provided this forum for the exchange of ideas and for friendly re acquaintances.

In particular,

For developing a stimulating program, we thank Peter Hall, Les Safranyik, and Dan Miller.

For arranging these comfortable accommodations in British Columbia's beautiful Okanagan, we thank Lee Humble.

For their cheerful assistance with registration, we thank Julie Brooks and Margot Hollinger.

For their successful efforts in putting together informative and productive workshops, we thank the moderators and participants.

And last, but not least, for his diligent leadership during the last two years, we thank our departing conference chairman, Terry Shore.

The resolution was seconded and unanimously approved.

6) Nominating Committee Report

John Wenz announced the following nominations:

Chairperson: Iral Ragenovich
Counselor: Nancy Rappaport

Nominations were moved and seconded as read, and the vote was unanimous in favor of the nominations.

In addition it was announced that Les Safranyik will replace John Schmid on the Awards Committee. A new chairperson will have to be selected.

7) Future Meetings

1994 - New Mexico at the invitation of Dayle Bennett

8) Other Business

a) PSW moving

Nancy Rappaport mentioned that PSW is moving to Albany the new address is:

800 Buchanan St.
Albany CA 94710
(510)559-6300

They will continue to use the same mailing address as before for a while:

PO Box 245
Berkeley CA 94701

b) Southern Forest Insect Work Conference

Scott Salom invited the group to attend the Southern Forest Insect Work Conference

c) Local participation
A suggestion was made that when this group meets, it offer to put on programs at local schools.

Chairperson Ragenovich adjourned the meeting.

## PANEL SUMMARY: FUTURE SHOCK, AN EXAMINATION OF POTENTIAL IMPACTS OF A CHANGING SOCIETY AND A CHANGING ENVIRONMENT ON FOREST HEALTH ISSUES

**Moderator: John H. Borden**, Professor, Centre for Pest Management, Simon Fraser University, Burnaby, BC. V5A 1S6

### INTRODUCTION

**John Borden**

In forestry and forest entomology, many of us live at least partly in the past, fondly recalling a newly planted forest, a research project accomplished, or a successful operational pest management program that happened 10 or 20 years ago, just as if it happened yesterday. Yet the world around us is changing, sometimes very rapidly. When I returned to British Columbia as a professional in 1966, we were still well within the era in which progressive clear cutting of old growth timber was considered to be good forest management. We were spraying lindane on log booms in Lake Cowichan to control ambrosia beetles. Biodiversity was in no lawyer's vocabulary that I ever heard. And summer and winter came and went with monotonous, uninteresting regularity. Now, many of us are suffering future shock as the world changes around us. Suddenly old growth is a religion, lindane is an antique, owls are political tools, and each long, hot summer is a little longer and a little hotter. All of the change we face must in some way affect forest pest management.

This panel addresses future shock in forest pest management. It provides a British Columbia perspective on our subjects: old growth management, pesticide regulation and usage, new forestry, and global climate change.

### OLD GROWTH MANAGEMENT

**Warren Mitchell:** Manager, Old Growth Strategy Project, B.C. Ministry of Forests, 1450 Government St., Victoria, BC. V8W 3E7

Forest management practices that have been traditionally utilized in British Columbia are changing as social values and public expectations for forests and forestry are changing. The relatively simple focus of resource extraction, especially of timber and wood products, is giving way to broader societal concerns for the consideration of forests as complex ecological systems that are vital to the maintenance of a healthy environment and that deliver a range of values beyond resources.

In this regard it is becoming increasingly necessary for forest managers to find new and innovative solutions to the potentially contrary objectives of forest sustainability versus forest resource utilization. Forest pest managers will be especially challenged as management practices change to maintain, enhance or create old-growth characteristics across the forest landscape.

Old growth attributes can be managed for at the stand or the landscape level. Stand management techniques which may become common are: maintenance of live trees in reserves or within a harvest unit; extended rotations or cutting cycles; uneven-aged or irregular stand structures; retention of coarse woody debris; retention or production of snags; and, increased mixes of species, including deciduous.

Landscape level techniques would ensure that there is a mosaic of forest stands, including old growth, across the forest unit with the objective being to maintain biodiversity.

The delivery of these objectives and techniques will be a significant challenge to pest mangers as the maintenance of old-growth attributes will require the protection or creation of pest habitat rather than its removal.

**PESTICIDES**

**Ron Kobylnyk:** Director, Pesticide Management Branch, BC. Ministry of Environment, 780 Blanshard St., Victoria, BC. V8V 1X5

We shall assume that by the year 4000 we will still have forest and forest pests. The public tends to favour "organic" solutions to pest problems because of a fear of chemicals. This fear is based on blame for diseases arising from a single unavoidable event, resentment of the power and indifference of large corporations, the desire for "sanctity" of nature, the fear of unfamiliar risks and the loss of controlling a risk.

We must do a better job of explaining risks to the public, including relative risks such as probabilities which are often based on uncertainties and extrapolations. Both industry and scientists must learn to do a better job of explaining risks and benefits to the public.

B.C. Environment is embarking on a new strategic plan which includes two new objectives: integrated pest management and a communication plan. One of the features of the IPM objective is to reduce pesticide use by 25% in 10 years and by developing a data base of IPM strategies used in BC and

elsewhere in the world. The Ministry will also be introducing the idea of major pesticide users being encouraged to develop corporate pest management plans. A number of public workshops are planned dealing with major pest problems. As scientists we must learn to simplify an issue to both the media and the public and we must deliver our message with passion. Rather than working in isolation, we must learn to participate in stakeholder meetings and strive for an informed consensus.

The Freedom of Information Act will finally allow the public to obtain information on pesticides which has remained unavailable until now. As long as we involve adequate public input into our long-term strategies, the impact of future shock in relation to pest control should be minimal.

**NEW FORESTRY**

**Norm Alexander:** Instructor, Renewable Resources Technology, B.C. Institute of Technology, 3700 Willingdon Ave., Burnaby, BC. V5G 3H2

I offer a restricted definition of new forestry in relation to forest health, in which biological diversity and global ecology take precedence over the production of forest products. The profound similarities between the effects of new and old forestry are pointed out and the suggestion is made that while the reasons may be very different for the old vs. the new forestry, the results can, in some instances, be very similar. I suggest that new isn't necessarily good, while old isn't necessarily bad. Nor is old always best just because we know how to do it, while trying something new isn't bad just because it entails some risk. Instead of denying the past, we should attempt to learn from it, to understand why things happened, and what came as a result of those actions. The constraints that brought about the old version of new forestry are discussed: physical constraints, market constraints, overabundance. The effects of these old harvesting methods are discussed. Clearcutting is suggested as a means to increase biological diversity. Burns are mentioned as another source of bio-diversity. It is pointed out that reforestation was not always a problem under some of these old harvesting methods. This old forestry left us with a legacy of problems, almost all of which are a result of less intense management practices. *Bark beetle outbreaks, ambrosia beetles, dwarf mistletoe, root rots, genetics-genetics-genetics!!!, and western spruce budworm.*

The sequence of procedures as followed by other plant and animal practitioners is discussed. The retention and/or enhancement of other forest values is mentioned. The lack of *time* is mentioned. Forest land management is not going to

allow the natural cycles to heal the wounds as these cycles take vast amounts of time. I suggest that we can have some of our cake and eat it too. Pathogens are defined as *site degradation factors*: the presence of living disease causal organisms is as much of a *site degrading factor* as anything else that we more routinely take into consideration. It is pointed out that we are going to have to accept both if we launch into less intensive forestry. I suggest that we should learn from the past before we blindly plunge into a "new" future.

**GLOBAL CLIMATE CHANGE**

**John Borden**

The greenhouse effect is a normal condition whereby infrared radiation from the earth's surface is reflected back by atmospheric greenhouse gasses such as carbon dioxide, methane, ozone, nitrous oxide and chlorofluorocarbons. It keeps the mean temperature of the earth's surface at a comfortable 15$^{o}$ C, instead of -18$^{o}$ C without greenhouse gasses. Since 1860 the mean temperature of the earth's surface has risen about 0.6$^{o}$ C. Associated with this increase has been a rise in atmospheric carbon dioxide from 260 ppm in 1800 to 350 ppm today. This trend is continuing. Some feel that a rise in atmospheric carbon dioxide may be beneficial to plants, because an expected increase of 33% in biomass production should occur. Plants in such an atmosphere might become temporarily resistant to insects because of reduced foliar water and nitrogen, but such characteristics should induce evolution in favour of voracious insects that can consume excess carbohydrate in order to meet their nitrogen quotas. If global warming results in a predicted trend toward wetter climates in coastal areas, the impact on host trees and pest organisms may be mixed. For example, host trees may stay very vigorous throughout the year if there is no summer water deficit, but insects vulnerable to mid-summer desiccation should also benefit. A rise in mean temperature in continental areas should be manifested in slightly earlier springs, warmer summers, later autumns and warmer winters. Under such conditions the natural host range of many tree species will move northward and upward in elevation, leaving numerous trees and stands off-site, and vulnerable to pest depredation. A warming trend could favour forest insect pests in several ways, including: expansion of geographic ranges, increase in number of generations per year, better overwintering survival, more frequent outbreaks, longer outbreaks, and the ascension of secondary pests to major pest status. In anticipation of these events, policy should be adopted to place a greater investment in intensive silviculture to shorten the rotations of vulnerable stands,

to intensify pest surveillance and management efforts, and to alter reforestation practices so that the most genetically adaptable trees are on site in the future.

## WORKSHOP SUMMARY: COMPETITIVE INTERACTIONS BETWEEN PRIMARY AND SECONDARY BARK BEETLES

**MODERATOR: Dan Miller,** PheroTech Inc., Vancouver

PARTICIPANTS: 20-30

Seven members presented information concerning the two following types of competitive interactions: (1) direct or scramble competition, primarily for phloem resource by offspring; and (2) indirect or contest competition, primarily in the use of pheromones. With respect to the first type of interaction, Jorge' Macias-Samano discussed the Mexican experiences in effectively using the cut-and-leave strategy to control *Dendroctonus mexicanus, D. frontalis* and *D. adjunctus* in pine forests. The actual mechanisms for population regulation are not known. Leo Rankin presented his research results in using the larvae of *Ips pini* to reduce the reproductive success of *D. ponderosae* in stands of lodgepole pine. Attack densities of both species and the interval between attacks of the two species were found to be critical in the effectiveness of the interaction. Les Safranyik followed with his ongoing research to capitalize on Leo's results. He presented some preliminary results showing success in attracting large numbers of *I. pini* to trees infested with *D. ponderosae* using the combination of ipsdienol and lanierone. Ed Holsten discussed his experiences with competitive interactions between *Dryocoetes affaber* and *Dendroctonus rufipennis* in Alaska. With respect to the second type of interaction, John Wenz discussed attempts by him and Pat Shea to protect slash from attack by *I. paraconfusus.* However, the use of racemic ipsdienol and verbenone could not be evaluated for effectiveness due to low populations of *I. paraconfusus.* Interestingly, the slash was heavily attacked by *D. brevicomis* instead. According to John Borden, similar work conducted by Darrell Devlin demonstrated that the combination of verbenone and ipsenol was successful in protecting slash in thinned stands of lodgepole pine. Finally, Skeeter Werner discussed some attempts to use various pheromones such as ipsdienol to reduce populations of spruce beetle in Alaska. His research is ongoing with emphasis on various pheromones of common bark beetle associates of the spruce beetle.

**WORKSHOP SUMMARY: FOREST HEALTH INPUT INTO IRM PLANNING**

**Moderator: LeRoy Kline**, Oregon Department of Forestry

Participants: 23

As expected, there was a lot of heated discussion trying to define forest health, a healthy forest, and an unhealthy forest. Highlights of the discussion follows. Forest health does not necessarily equal tree health, which most entomologists are interested in. It is a very broad, complex subject with both real and perceived problems. Forest health can be described by many standards, each related to the management objectives for a specific site. No single standard of definition covers all objectives. Other questions were raised such as: What specifically do we want to maintain or create? Will we know it when we see it? Do we all see the same thing? Should we or can we legislate, regulate, or initiate forest health?

The moderator offered a definition that is currently being used by the Oregon Department of Forestry. "Forest health is a condition where dynamic forest ecosystems contain and sustain productive soils, clean water and air, a rich diversity of species and effective life-sustaining ecosystem processes. This ecosystem is resilient to change in terms of the risk of present and future disruptions by natural and human-caused events. Healthy forest provide people and communities with a variety of goods and services that can be produced from the land consistent with people's needs and basic land stewardship. Goods include tangible products, such as timber, fish, water and wild life. Services include intangible benefits, such as visual, historical, cultural, and spiritual values. A healthy forest should equate to a healthy ecosystem."

The major challenge of a Forest Health Program in the future is to show how it will support forest management goals to implement integrated resource management, and to demonstrate that the concept of forest health is valuable and practical. Forest health should also emphasize the belief that the forest - not the pests - as our major concern. An ecosystem approach using watersheds as the working base is perhaps necessary to accomplish desired future conditions.

Several examples were given on the Canadian and US side on how pest specialists were trying to integrate forest health principles into resource management planning.

## WORKSHOP SUMMARY: 1991 REGIONAL FOREST INSECT PEST UPDATES

**Moderator: L. Livingston,** Idaho Department of Lands

### FOREST INSECT CONDITIONS, BRITISH COLUMBIA & YUKON

**G.A. Van Sickle,** Forestry Canada, Victoria, BC.

The most damaging pests in the region in 1991 were bark beetles. These included **mountain pine beetle** which killed nearly 2 million cubic meters of mature pine in 9065 infestations over 49,600 ha in six forest regions. Increasing **spruce beetle** populations killed mature spruce over 44,600 ha mostly north of Mackenzie, but declined at Bowron Lakes Park. **Balsam bark beetle** killed mature alpine fir over 62,500 ha and **Douglas-fir beetle** killed mature trees in 3160 groups over 3865 ha in six regions.

Major defoliators included **western spruce budworm** which defoliated stands totaling 395,000 ha in three regions, more than double the area and severity of last year. With a 20% increase in egg counts, defoliation is forecast to continue in 1992 with severe defoliation at two thirds of the sites. **Douglas-fir tussock moth** defoliated trees over 135 ha near Kamloops and is forecast to increase in 1992. **Eastern spruce budworm** defoliated alpine fir and spruce in 135 stands over 245,000 ha near Fort Nelson, down 40% from last year, but **2-year-cycle budworms** increased with defoliation over 36,000 ha. Old-growth western hemlock was defoliated by **western hemlock looper** in 265 patches over more than 50,000 ha, up from only 1115 ha in 1990, and by **grey spruce looper** over 3850 ha. This was a three fold increase from last year and the first recurrence of ***Caripeta divisata*** in more than 320 acres over 113,000 ha in three regions. The Asian biotype of **gypsy moth** was trapped for the first time in North America in the Vancouver area. The European biotype was also trapped with a combined total of 72 adult males in 17 areas.

Other noteworthy forest pests included **pine needle diseases**, which were again common, but **western black headed budworm** and **pine sawfly** collapsed in coastal areas. **European pine shoot moth** is established in urban ornamentals but not in native pines. **Pinewood nematode** remains very rare. **Balsam woolly adelgid** was found slightly east of the quarantine zone in southwest B.C. **Larch needle diseases** were widespread but other larch pests including **casebearer** were generally endemic. An introduced oak leaf **phylloxeran** and the native jumping gall wasp increased on Garry oak in Victoria, but **western winter moth** populations remain low.

Plantation and regeneration pests were common with varying degrees of damage, and included **black army cutworm, Rhizina**

**root disease, climatic injury, animal feeding, root diseases, terminal and root collar weevils,** and **stem rust cankers**.

## PACIFIC NORTHWEST REGION

**David R. Bridgwater,** USFS R-6, Portland Oregon

The states of Oregon and Washington experienced their seventh consecutive year of below normal precipitation in 1991. In addition, areas of Eastern Oregon and Washington have been defoliated since 1980 by **western spruce budworm**. In response to these factors, many areas have experienced high levels of bark beetle caused mortality. Bark beetle mortality decreased in 1990, but generally showed an increase in 1991. Aerial detection surveys showed 1.1 million acres region wide with current bark beetle mortality.

Mortality caused by **fir engraver** and **mountain pine beetle** in ponderosa pine increased. While true fir mortality continues in areas defoliated by **western spruce budworm**, extensive mortality occurred outside of defoliated areas, and mortality caused by **Douglas-fir beetle** and **mountain pine beetle** in lodgepole pine decreased. **Mountain pine beetle** continues its decline from 15 years of outbreak since most on the suitable host have been killed. **Douglas-fir beetle** had been more active in areas of budworm defoliation, however, over the last two years, has declined. Field observations indicate a possible resurgence in activity in 1992.

**Western spruce budworm**, had declined to 1.7 million acres in 1989, but has increased to 2.7 million acres in 1990 and 4.7 million acres in 1991 with somewhat higher vigor. It is unclear where budworm populations are headed over the next few years.

## CALIFORNIA FOREST PEST CONDITIONS

**John Dale,** USFS R-5, San Francisco, California

As the drought continued into the sixth year, the amount of tree mortality from attacks by **bark beetles** appeared to be static or decreasing in the southern Cascade Mountains and in the Sierra Nevada Mountains. Several districts reported that salvage of tree mortality was down because newly faded trees were not as common as in past years. This may or may not be attributable to the rains of March 1991, the cool spring and summer weather, and the influence of drought on the thickness of inner bark and subsequent bark beetle reproduction, increases in invertebrate parasites and predators, or the fact that mortality on the more harsh sites had already occurred. On the other hand, reports of tree mortality

connected with attacks by roundheaded and flatheaded borers increases in 1991.

For the first time in a least a decade, the **spruce beetle** was reported as killing Sitka spruce in California.

Defoliating insects, such as the **Douglas-fir tussock moth** and the **spruce budworm**, continued to exist at population levels that were endemic or causing damage that cannot be easily detected. **Gypsy moth** trap catches were even lower than in 1990. However, ominous developments are the presence of egg masses of the **Asian gypsy moth** on a Russian ship in Oregon prior to its arrival at a port in California, and the trapping of an Asian gypsy moth in the state of Washington, 12 miles from the nearest waterway. The Oregon Department of Agriculture trapped several suspect moths that are currently under examination by specialists. The California Department of Food and Agriculture is taking steps to address this potentially serious pest problem.

**Aphids, scales**, and **psyllids** appeared to be more abundant and damaging during 1991 than in recent years. A new introduction affecting urban eucalyptus and the commercial nursery industry is the **blue gum psyllid**.

## FOREST INSECT CONDITIONS IN ALASKA

**Roy Mask,** USFS R-10, Juneau, Alaska

Forest insect populations and subsequent damage have increased in recent years in various parts of Alaska. Forest insect activity in interior and south-central Alaska has increased in association with three consecutive years of favorable spring and summer weather. During this same period, insect activity in Southeast Alaska has remained comparatively low, due in part to the influence of the cool, wet, maritime climate.

During 1991, active **spruce beetle** infestations in south-central and interior Alaska totaled approximately 375,000 acres. Ongoing outbreaks expanded along the Copper River, on Kenai Peninsula, along portions of the west side of Cook Inlet, and along the Yukon River. **Spruce beetle** activity in Southeast Alaska continued to expand with Glacier Bay Natl. Park and along the Klehini River, affecting almost 16,000 acres of Sitka spruce.

**Eastern spruce budworm** defoliated approximately 20,000 acres of white spruce near Fairbanks and Delta Junction in 1991. **Spruce budworm** activity in Southeast Alaska, near Haines, declined significantly from levels reported in 1990. Defoliation of hardwoods increased throughout Alaska for the

second consecutive year. The most spectacular hardwood defoliation in south-central and interior Alaska was that of willow, which totaled approximately 130,000 acres. Willow defoliation was caused by **leaf miners, noctuid** and **rusty tussock moth** larvae. **Black-headed budworm** defoliation of western hemlock and Sitka spruce has declined for the past two years in the Prince William Sound area, while there has been a slight increase in activity in Southeast Alaska. **Hemlock sawflies** have been at endemic levels for several years in Southeast Alaska, though populations on the southern Tongass National Forest appear to be increasing.

## INSECT CONDITIONS, SOUTHWESTERN REGION

**Jill Wilson,** USFS R-3, Flagstaff, Arizona

In the southwest, total acres of **bark beetle**-killed trees increased from 66,350 acres in 1990 to 107,620 acres in 1991. Within the ponderosa pine forest cover type, **western pine beetle** activity increased dramatically, causing a large majority of the volume loss (8,917,550 cubic feet), followed by ***Ips* engraver beetle** (539,280 cubic feet), and **mountain pine beetle** (143,250 cubic feet). ***Ips* engraver beetles** also caused an estimated volume loss of 6,000 cubic feet within the pinyon-juniper forest cover type. This is significantly less than the volume lost in 1990 (1,140,000 cubic feet). In the mixed conifer and spruce forest cover types, **Douglas-fir beetle** and true **fir beetle** attacks caused an estimated 168,250 and 177,600 cubic feet of volume loss and **spruce beetle**, 42,750 cubic feet of volume loss.

Defoliator activity Regionwide decreased from 314,250 acres in 1990 to 247,760 acres in 1991. Most of this defoliation was due to the **western spruce budworm** which defoliated an estimated 218,610 acres of the mixed conifer forest cover type. Aspen defoliation resulting from an insect and disease complex composed of the **large aspen tortrix**, **western tent caterpillar**, and **marssonina leaf blight** increased significantly Southwestwide from 3,670 acres in 1990 to 29,150 acres in 1991.

## FOREST INSECT PEST CONDITIONS, USFS NORTHERN REGION

**Larry Stipe,** USFS R-1, Missoula, Montana

The **mountain pine beetle** remained the most devastating insect pest in the Region. Though infested acres continued a decline that began in 1982, the decrease in 1991 was less than in previous years. In northern Idaho, there was actually an increase in affected acres--up from 800 in 1990 to more than 3,200 in 1991 with an estimated 9,200 trees

killed. In Montana, there was a noticeable decrease in infested area from more than 198,000 acres in 1990 to only 160,000 acres in 1991. Approximately 99% of the mortality was lodgepole pine. Dead tree volume totaled more than 35 MMBF.

Total area affected by the **Douglas-fir beetle** declined Region-wide. In North Idaho the infested area declined markedly, from more than 8,000 acres in 1990 to more than 5,300 in 1991. An estimated 12,000 trees--nearly 4.2 MMBF--were killed. In Montana, total infested area remained almost static--9,125 acres in 1990 and 8,035 acres in 1991 with approximately 10,600 trees killed containing an estimated 3.1 MMBF.

Responding to more-nearly normal precipitation for the third consecutive year, **fir engraver beetle** populations declined notably again in 1991. In northern Idaho, in 1990, more than 36,000 acres had been infested with 53,000 trees killed. In 1991 14,700 trees were killed on 5,600 acres. In Montana, less than 650 trees were killed on 500 acres.

**Pine engraver** populations declined to low levels in northern Idaho in 1991 with only 80 dead ponderosa pine recorded on 15 acres. In Montana, continuation of drought and effects of widespread fires in 1988 resulted in increased mortality in pine stands. Infestations covered more than 3,000 acres of ponderosa pine on the Northern Cheyenne IR and adjacent Custer NF and 5,000 acres of lodgepole pine on the Gallatin NF surrounding and within Yellowstone NP. In both species, more than 6,500 trees were killed.

Though **spruce beetle** remains virtually endemic throughout the Region, infested area increased in the southwestern portion, on parts of the NezPerce NF, Idaho. Engelmann spruce stands in that part of the State are still drier than normal, and are experiencing population increases associated with outbreaks to the south, on the Payette NF. Infested area increased two-fold, from 591 acres in 1990 to almost 1,200 acres in 1991. Just over 1,500 trees were killed. In Montana, only 128 trees were killed on 113 acres.

In Idaho, fewer than 900 dead subalpine fir, in small groups, on just over 200 acres were attributed to **western balsam bark beetle** attacks in 1991. In Montana, infested acres once again increased on the Gallatin and Beaverhead NF's. Statewide, predominantly in the western portion, the infested area increased from 5,500 acres last year to 7,300 in 1991.

**Western pine beetle** populations, and affected ponderosa pine stands, decreased markedly in 1991 in North Idaho from over 9,900 acres in 1990 to fewer than 2,000 acres in 1991.

Slightly more than 6,400 trees were killed in 1991 compared to more than 46,000 in 1990. In Montana, conditions remained static; 350 trees were killed on 600 acres in 1991. Most mortality, in both States, was observed in relatively small, scattered locations.

**Western Spruce Budworm** caused defoliation increased from 1,487,790 acres in 1990 to just over 1,607,000 in 1991. Most of this increase occurred in Montana along the Continental Divide in stands damaged by cold temperatures in January of 1989.

The budworm outbreak on the NezPerce National Forest of Idaho increased from 5,400 acres in 1990 to 12,200 acres in 1991. Heaviest defoliation has been limited to widely scattered high-elevation true fir stands above the Salmon River near Riggins, Idaho.

In northern Idaho, **Douglas-fir Tussock Moth** pheromone trap counts showed a slight increase during 1991, but averaged well below one moth per trap. In Montana, trap counts averaged just over six moths per trap. No visible defoliation was reported in either Idaho or Montana. If the northern Idaho outbreak cycle repeats as expected, the next population peak in the Palouse area should hit sometime around 1995.

As part of an early detection program in the Northern Region over 5800 **gypsy moth** pheromone traps were deployed. Traps were concentrated near high-use recreation sites, along major travel routes and most urban areas. Eight moths were caught -- three in Montana, three in North Dakota, two in northern Idaho. Following an eradication program in northern Idaho no moths have been caught since treatment ended in 1990.

Widespread **Balsam woolly adelgid** mortality occurred in many areas in northern Idaho in 1991. The cause has not been determined; however, weather conditions may be at least partially responsible. Even though the adelgid populations have been reduced, over 10,000 acres of subalpine fir mortality were recorded during aerial surveys. Most of the damage occurred on the Clearwater National Forest and adjacent state and private land.

**Girdler moth** pheromone trap counts at the Coeur d'Alene Nursery were at an all time high during 1991. Damage in the Douglas-fir and larch seedling beds was kept within an acceptable level by both adult and larval pesticide treatments.

## FOREST INSECT PEST CONDITIONS, USFS ROCKY MOUNTAIN REGION

**Bernie Raimo,** USFS R-2, Gunnison, Colorado

The **mountain pine beetle** in ponderosa pine continues to be the most damaging pest in Region 2. In south Dakota tree mortality increased significantly in the Black Hills where 33,000 trees on 11,000 acres were killed. In Colorado's Uncompahgre Plateau populations decreased but remained a problem. In Wyoming populations persisted in the Bighorn National Forest and covered about 11,000 acres on the Medicine Bow National forest. Populations of the **roundheaded pine beetle** and the **western pine beetle** have persisted in Colorado associated with the **mountain pine beetle** outbreak. **Pine engraver** populations continue to be abundant in ponderosa pine throughout most of the Black Hills in South Dakota and Wyoming. **Red turpentine beetle** populations were heavy in standing stumps resulting from tornado damage in the Black Hills.

**Douglas-fir beetle** populations in Wyoming spread from trees blackened by fires in 1988 to nearby scorched and green trees. In 1991 about 2500 trees were infested with greater mortality expected in 1992. Populations decreased in Colorado but spot infestations were found along the Front Range.

The **western spruce budworm** defoliated approximately 509,000 acres in Colorado in 1991. The outbreak is expected to continue in 1992. **Pine tip moths, pine sawflies** and the **pandora moth** caused damage to pines throughout the region, including Christmas tree plantations, windbreaks, landscape plantings, and natural stands. **Gypsy moths** were caught in single catches throughout the region. In Nebraska, infested nursery stock was shipped from Pennsylvania then outplanted at several locations. Single moth catches occurred in Lincoln, Beatrice and in the Nebraska National Forest near Valentine, Nebraska; in campgrounds near Spearfish and Rockerville, South Dakota. In Wyoming one moth was caught on the Bighorn National Forest. No moths were caught in Colorado.

## WORKSHOP SUMMARY: HAZARD AND RISK RATING FOR FOREST INSECTS

**Moderator: Terry Shore,** Forestry Canada, Victoria

Participants: Lorraine MacLauchlan, Keith Reynolds, Jan Volney

Attendance: Approximately 30 people

Current research on the development of hazard and risk rating systems for four insect pests were highlighted in presentations by Lorraine MacLauchlan (B.C.F.S., Kamloops), Keith Reynolds (U.S.F.S., Anchorage), Jan Volney (Forestry Canada, Edmonton) and Terry Shore (Forestry Canada, Victoria). The pests that were profiled affect a range of stand types from young to mature and included two bark beetles, a defoliator and a weevil.

### Hazard Rating Index for *Pissodes terminalis*
### L. MacLauchlan

The incidence and impact of *P. terminalis* is greatest on immature lodgepole pine grown in the dry, low elevation Interior Douglas-fir (IDF) biogeoclimatic zone. The Montane spruce zone (MS) also has a very high hazard and since it encompasses most of B.C.'s lodgepole pine type, this ecosystem could be considered equal in hazard to the IDF. The Engelmann spruce-subalpine fir zone (ESSF) has the lowest hazard for *P. terminalis*.

The parameters used to determine hazard are biogeoclimatic zone, stand age, and density or area potentially available (APA) In high hazard zones, lowering the density of a stand or giving individual trees greater APA's will increase the hazard of that tree or stand. Larger, more open grown trees have a higher probability of being attacked by *P. terminalis* and subsequently also develop more severe defects than trees in a more crowded situation. Stands aged 5-25 years are highest hazard. Hazard decreases beyond 25 years.

### Hazard Rating Jack Pine Stands
### J. Volney

The jack pine budworm feeds almost exclusively on jack pine. Stand susceptibility varies considerable over the region in which outbreaks have occurred. The biological basis for this variation is under investigation. Age is one factor which determines the extent to which a stand is damaged; older stands, especially over 60 years of age are more susceptible. Stand density is known to influence defoliation. Open-grown trees, which flower profusely support larger populations of the jack pine budworm and thus

sustain more damage. Within stands, trees which are infected with root disease sustain more damage than uninfected trees. A combination of these factors can be considered in developing hazard rating schemes for jack pine stands at risk to damage from the jack pine budworm.

**Hazard Rating for Spruce Beetle on the Kenai Peninsula**
**K. Reynolds**

Tree regression analysis was used to identify significant components of a hazard rating system for spruce beetle in Lutz spruce on the Kenai peninsula. Variables included in the analysis were aspect, elevation, mean 10-year increment of dominant and co-dominant spruce, total basal area, spruce basal area as a percent of total basal area, basal area of spruce with dbh > 25cm as a percent of spruce basal area, and basal area of spruce beetle-caused mortality in the past 10 years as a percent of spruce basal area. Nodes were recursively pruned from the full regression tree to evaluate alternative simplified tree structures. The final version of the regression tree contained 7 terminal nodes with 3, 2.1, and 1 branches leading to predictions of low, low-medium, medium high and high hazard, respectively.

**Susceptibility and Risk Rating Systems**
**for the Mountain Pine Beetle**
**T. Shore**

Systems for rating the susceptibility (=hazard) and risk of lodgepole pine stands to the mountain pine beetle have been developed (Shore and Safranyik 1992, For. Can. Inf. Rep. BC-X-336) and are being utilized in British Columbia. Risk is defined as the short term expectation of tree mortality in a stand and is considered to be a function of stand susceptibility and beetle population pressure. Factors affecting the susceptibility of a stand are: age of the dominant and co-dominant pine, location (elevation, latitude, longitude), stand density, and the basal area of pine >15 cm as a percentage of the total basal area of the stand. Beetle population pressure is an index of the magnitude and proximity of a significant mountain pine beetle population to the stand being assessed. Susceptibility and risk indices ranging from 0 to 100 are produced for each stand and are useful for prioritizing treatments.

**WORKSHOP SUMMARY: IMPORTANCE OF HOST VOLATILES TO FOREST BEETLES**

**Moderator : Dan Miller, PheroTech Inc.**, Vancouver

Participants: 25-30

Seven members presented information concerning the effects of host volatiles on predicting the behavior of forest beetles, particularly wood borers and bark beetles. Ron Billings discussed the importance of turpentine (released at high rates) in attracting southern pine beetle. Don Owen discussed the association between attraction of red turpentine beetle and diseased host material. Beetles are attracted to such material. Don did not specify active compounds. John Borden stated that myrcene is not required for tree baits for mountain pine beetle. Attack densities and overflow attacks did not differ when myrcene was absent. Dan Miller noted that myrcene is important in attracting mountain pine beetle in stands of white pine, more so than a-pinene as previously stated by other authors. Ron Billings said that he had found similar results. Ed Senger discussed some preliminary work with various wood borer species (Cerambycidae and Buprestidae) in log storage areas. Damage is evident and attempts are underway to develop a control program. Skeeter Werner discussed research on the attraction of spruce beetles to various monoterpenes. Finally John McLean reviewed the data on the use of host volatiles, particularly ethanol and a-pinene, to attract ambrosia beetles, particularly the striped ambrosia beetle. Scott Salem discussed his wind tunnel work and queried the use of the current lure sold by Phero Tech. Jerry Carlson stated that the use of the current lure is based on insuring that errors are not made since some of the published results are contradictory.

**WORKSHOP SUMMARY: SECOND GROWTH PESTS**

**Moderator: Tim Ebata**, B.C. Forest Service, Smithers

Participants: 25 (75% Operational BCFS and Industry staff)

Because of the breadth of the topic, an open workshop format was used. Participants were asked to identify themselves as operational or research oriented and to list topics they wished to discuss. The group chose the following general topics:

1. Forest Management Practices Exacerbating Pest Damage: The creation of large scale clearcuts that began large single species, single aged stands followed by an outbreak of spruce

weevil was the most common example of a pest problem caused directly by forest management practices. A discussion on partial cutting dwelled on the destruction of advanced regeneration by western spruce budworm in uneven aged stands. There may be a problem with Warren's root collar weevil killing young pine in partially cut stands or invading region in small clearcuts. **Ips** (engraver beetles) have the potential to breed up in slash in pre-commercial and commercial thinned stands.

2. Do Monocultures Breed Healthier Pests? The group concluded that there were no true monocultures except fire regenerated lodgepole pine stands. In most stands, there are unnaturally high proportions of one species growing among several other naturally regenerated species. The group generally agreed with the question again citing the spruce weevil in "monoculture" spruce plantations as the best example. Perhaps another form of "monoculture" is regeneration with a limited supply of "improved" genotypes that go beyond their natural ranges. This situation could result in a major pest problem in the future. However, forest geneticists argue that biodiversity is selected for through the tree breeding program.

3. When is a Pest a Pest? Economic analysis has only been done for the treatment of western spruce budworm. In the U.S., it was shown to be uneconomic. In B.C., the same treatment was marginally economically beneficial. Such analyses do not require a lot of data but can be based on expert opinions. A cost: benefit analysis for spruce weevil will be close at hand once an analysis of how the weevil affects wood quality is completed by Dr. Rene Alfaro of Forestry Canada in Victoria.

Long run sustained yield projection models have shown little affect of second growth pests over 200 yr time frames. However, there may be major impacts on the short-term timber supply by these pests. It is important not to look at single pests and their impact on growth and yield but look at all possible pests that may affect the stand from regeneration to rotation. Much more work is required in this area.

4. Collecting and Tracking Second Growth Pest Data Pest data is presently collected in various forms and methods (i.e. pest specific surveys, permanent sample plots, silvicultural surveys, etc.). In the U.S., different agencies and different regions each collect such information using their own methods. No specific ground survey has been developed. In B.C., the B.C. Forest Service and Forestry Canada are attempting to develop compatible young stand pest incidence surveys over the next three years. Nelson and Kamloops regions have done extensive ground incidence surveys

to collect basic incidence data. There is a major opportunity to collect pest incidence data using existing silvicultural surveys. In B.C., there are three or more mandatory surveys that could be utilized: the preharvest silviculture prescription (1-3 yrs before harvest), the stocking survey (1-2 yrs after harvest) and the free growing survey (6-15 yrs after harvest). There is also a pre-stand tending survey that is usually done prior to spacing, pruning, fertilizing and other treatments.

In B.C., permanent sample plots for growth and yield studies have not collected pest data. Plots were abandoned or moved if pest incidence significantly affected the results. Timber supply analyses usually "net down" expected volumes due to numerous factors including unsalvageable pest damage. However, pest specialists have an opportunity to provide more accurate estimates of pest caused losses which may increase expected volumes.

The USFS has installed a network of permanent plots to answer Congress' query about the health of the nation's forests and other ecosystems. These plots provide a very broad monitoring system to detect changes in the represented ecosystems.

To date, pest data in B.C.'s silvicultural records has been of marginal quality and utility. The current emphasis in the BCFS is to provide operational data collection standards and to increase training.

## WORKSHOP SUMMARY: INSECT POPULATION DYNAMICS AND SELECTION OF PEST MANAGEMENT STRATEGY

**Moderator: Les Safranyik,** Forestry Canada, Victoria

Participants: Roy Shepherd, Torgy Torgensen, Alan Berryman, Bob Coulson

About 25 persons attended the workshop. Les Safranyik introduced the theme and noted the main objectives; to discuss how information on the dynamics of injurious forest insects can be used for developing effective approaches to management, and to determine if there are current studies that were initiated because of a lack of information needed to develop improved strategies for pest management.

Roy Shepherd discussed the importance of considering the epidemiology of specific pest insects in developing effective methods of control, and defined two types of defoliating insect populations; fast cycling, and sustained. With fast

cycling species such as the Douglas-fir tussock moth, the western black-headed budworm, and the black army cutworm, damaging population levels appear suddenly, and usually decline to low levels within 1 to 4 years. Impact is more related to intensity of defoliation than to duration. For defoliators of this type the best management strategy is to prevent initial defoliation.

In contrast to fast cycling insects, populations of sustained defoliators such as the western spruce budworm, do not follow regular or predictable patterns. The rates of increase are generally slower than those of fast cycling species, the insects are highly mobile in the larval and adult stages, and are less habitat sensitive. Severe damage occurs only after several years of damage, and impact is therefore more related to duration than intensity. With insects exhibiting this type of population behavior, opportunities should be explored for creating long-term changes in the susceptibility or vulnerability of the forest.

Torgy presented the following based on his work and that of Dick Mason at the Forestry and Range Sciences Lab, La Grande, OR:

An understanding of the dynamics of insect defoliator populations can lead to many practical applications in forest pest management. Examples showed temporal and spatial patterns of populations of Douglas-fir monitoring in the Pacific Northwest. These examples represented both relatively natural populations, and populations upon which suppression projects using carbaryl and B.t. have been imposed. Empirical data are useful for predicting population trends, possible effects of suppression projects, and for identifying forests that are at high risk for outbreaks, or those that are under natural regulation at low densities. Serial data generated from the annual monitoring of permanent plots can also be used to construct general theoretical models that predict population change (e.g. POPSYS), or make probability statements about the Forests. Long-term data sets of defoliator populations will be critical to evaluating pest responses to silvicultural or other management practices.

Alan Berryman discussed, using blackheaded budworm as an example, development of population models based on fundamental concepts of population dynamics using a time sequence of data on population size followed by time series analysis. He elaborated on how these models are used for prediction of population behavior and prescription of pest management strategy.

Bob Coulson reminded us of several points regarding predictive modeling:

a) the need for careful planning when developing predictive models,
b) there is no need to model the obvious,
c) population dynamics data can often be used to predict qualitative changes in populations (increase, decline, static),
d) we must do a better job of selling the need and usefulness of population dynamics work in the practice of forest management.

**WORKSHOP SUMMARY: MALE DISRUPTION TECHNIQUES IN LEPIDOPTERA**

**Moderator: Christine G. Niwa, U.S. Forest Service**

Participants: 18

Lonne Sower discussed theories and principles of mating disruption. A better understanding of the mechanisms of mating disruption can help to answer some practical questions about application (e.g. type of formulation to use, dosage, and use of "off" blends). A geometric relationship exists between lure concentration and size of the effective plume, so dose must be increased several times to achieve a doubling of the area in which a male is attracted. The effective communication range within a species is difficult to predict, as it depends on female release rate, male threshold, and wind speed; in one species tested, the range was from 0.5 to 500 m. False-trail-following and sensory habituation are two of the mechanisms by which mating disruption occurs. Though not always vital to disruption, it is prudent to use as close to the correct pheromone as possible in order to facilitate false-trail-following. Moth behavior is also a factor in the efficacy of mating disruption. For example, at high population densities spruce budworm males often fly to trees and cruise branches rather than just relying on pheromone attraction to locate females.

Ian Weatherston discussed pheromone dispensers and factors affecting release rate. For a formulation to be efficacious it must emit the correct amount of pheromone in the correct component ratio over the desired period of time. The most important technical parameters are release rate, longevity, blend integrity and the stability of both the active ingredients and the device. These parameters were discussed in relation to the type and stiffness of the polymer used for the dispenser; size of the dispenser; the use of co-diffusants; molecular weight, functional group, and

unsaturation of the pheromone molecules; and the effects of sunlight and temperature.

Julie Weatherby gave a user's perspective of the mating disruption technique for the Douglas-fir tussock moth. In 1991, about 200 acres were treated in Idaho with hollow fibers applied by helicopter. A video of the application operation was shown, and Julie recommended that company assistance for mixing, installation, and calibration be included in contract specifications. Project costs (not including the helicopter) were about $40 per acre. Preliminary results indicate that populations were reduced about 70 percent with mating disruption.

Roy Shepherd reported briefly on a 1991 Douglas-fir tussock moth disruption test in B.C. which utilized a sprayable bead formulation applied by helicopter. Glass plates used to assess the application rate recovered only a small percentage of the intended dosage. However, this was sufficient to almost completely shut down trap catch. Longevity of the pheromone in these small particles is still a potential problem, particularly with compounds that have higher volatility than the tussock moth pheromone.

## WORKSHOP SUMMARY: WESTERN DEFOLIATOR MANAGEMENT STRATEGIES

**Moderator: John M. Wenz, U.S. Forest Service**

Participants : 45

The workshop provided a forum for discussion of historic and current defoliator management strategies (i.e., plans designed to move toward and hopefully attain specified management goals and objectives) in western North American coniferous forests.

Individuals making presentation included: Julie Weatherby (FPM-R4; Larry Stipe and Jed Dewey (FPM-R1); Bruce Hostetler (FPM-R6); and Dayle Bennett (FPM-R3). Most of the discussion centered around experiences with the western spruce budworm (WSBW). Generalizing, the tendency in the recent past has been to implement direct control for the primary purpose of foliage protection and reducing impacts on timber production. Region 6 currently continues to implement direct control for WSBW. The trend in other areas in the west seems to be toward more long-term oriented silviculturally-based management strategies. The workshop participants felt that defoliator (and other forest pest) management strategies are becoming more complex and need to be responsive to a changing resource management philosophy. This includes an increasing emphasis on non-timber, non-commodity, resource values,

biodiversity, and an ecologically based "ecosystem management" approach to resource management that involves differing scales of space and time. Participants identified some basic information needs (listed below) necessary to provide the basis for developing management strategies responsive to the changing resource emphasis:

(1) The need to document/quantify short - and long-term efficacy of treatment strategies relative to defoliator population dynamics and impacts on resource management goals and objectives.

(2) The need to obtain valid biological data needed to continue the development and validation of defoliator (a) population, (b) damage, and (c) impact assessment models, that consider a diversity of resource values.

The group also identified the need for improved coordination and communication throughout the west between pest management specialists/resource managers with respect to progress/results in obtaining the needed information.

**WORKSHOP SUMMARY: INCORPORATION OF LOSS DATA INTO TIMBER SUPPLY ANALYSIS**

**Moderator: Gerry Fraser,** Canadian Pacific Forest Products

Participants: Stuart Taylor, Jeff Beale, Marc Wiitala plus 20 others

Stuart Taylor, Pest Management Forester with B.C. Forest Service, Prince George Region gave an overview of the work done in B.C. since 1984 to survey past affects and to incorporate this data into timber supply analysis. Data has been collected for many of the main pests including several species of bark beetles, defoliators, dwarf mistletoes and root diseases. However, due to the absence of damage appraisal techniques, to determine impacts, few timber supply analyses have taken pest impacts into account. Work completed to date has helped in the establishment of research priorities.

Jeff Beale, Acting Manager Forest Productivity, B.C Forest Service, described recent work in B.C. to develop and integrate a forest damage appraisal strategy into existing growth and yield, forest inventory, silviculture surveys and timber cruising programs. Implementation of this strategy will lead to improved forest level yield prediction, planning and resource allocation. A working plan for the strategy which would include timelines, staffing and finding requirements is currently being completed.

Marc Wiitala, an economist with the U.S. Forest Service in Region 6 described the progress to incorportate pest loss information into timber supply analyses for national forests in the Pacific Northwest. Currently pest impacts are only accounted for at the project level and not at the forest planning level. Many current forest plans have been built on timber inventories from the late 1970's and early 80's. However, some forests have received major impacts since the last inventory and because of this, existing medium term yield projections are optimistic. In addition, current yield tables often assume incorrectly that future insect outbreaks will be totally and effectively treated. As in B.C. damage appraisal techniques are neither well developed nor understood. Interactions between silvicultural practices, expected pest activities and suppression strategies are also not realistically modelled.

Recently developed models such as Informs and the Parallel Processing Extension for the Prognosis model are seen as bright spots on the horizon in that they will permit stimulation, on an area basis the consequences of continuing different pest and resource management strategies. This information can then be plugged into the new generation of forest planning models which will be capable of handling many factors including pest impacts.

Following the formal presentations the group discussed why the integration of pest impacts has not yet arrived in either B.C. or the U.S. Aside from inadequate pest inventories and impact models, pest managers have not done a good job at selling the importance of pest impacts to forest level planners. With operability limits, land withdrawals and other forest values etc. to contend with planners may not see pest impacts as a high priority.

**WORKSHOP SUMMARY: WEEVILS**

**Moderator: Lorraine Maclauchlan**, B.C.F.S., Kamloops, B.C.

**Participants:** Gyula Kiss, BCFS, Kalamalka Research Station, Vernon, B.C.; Kornelia Lewis, University of B.C., Vancouver, B.C.; Brian Siebens, Univeristy of B.C., Vancouver, B.C.;Julie Brooks, Agriculture Canada, Summerland Research Station, Summerland, B.C.

This workshop highlighted the latest advances in research on weevils in the genus *Pissodes*, emphasizing work on genetic resistance and hazard rating systems. There has been a resurgence of research activity on *P. strobi* (Peck) in the

past few years and progress has been made in the above two areas. The lodgepole terminal weevil, *P. terminalis* Hopping, has also become of concern to foresters in young, regenerating stands of lodgepole pine, *Pinus contorta* var. *latifolia* Engelm., and this weevil was also discussed.

In 1968, the British Columbia Forest Service initiated a comprehensive tree improvement program for interior spruce. Large, open-pollinated progeny trials were established and at the 10-year measurement, light to moderate attack levels of *P. strobi* were detected. Cursory field examination indicated a pattern of differential attack among families. Thus a study was undertaken to determine the level of genetic variation in resistance to *P. strobi* attack, the magnitude of interactions among families and plantations for resistance, and to determine a relationship, if any, between weevil resistance and growth attributes. The results from this study suggest that there is a moderate genetic basis for resistance to weevil attack in interior spruce and that selection for height and diameter growth may improve resistance to *P. strobi* attack.

Studies on *Pissodes strobi* have suggested that this weevil preferentially attacks the longest and thickest leader of the tallest trees. However, a more recent study suggests that the genetic composition of individual trees may be more important than leader dimensions. Kiss and Yanchuk examined the pattern of *P. strobi* attack among families of interior spruce (the complex of white spruce, *Picea glauca* (Moench) Voss, Engelmann spruce, *P. engelmannii* Parry, and their hybrid swarms). Their data, comparing average percent weevil damage at ages 10 and 16 years, showed an inverse relationship (r=0.51), indicating that faster growing families are less frequently damaged that the slower growing ones. A similar relationship was shown for dbh, indicating that families with larger average dbh are damaged less frequently that those with smaller dbh. Other studies in the genetic resistance of spruce to *P. strobi* involved Sitka spruce provenance trials having records of fifteen tears of weevil attack, revealing large differences among provenances in percent of trees attacked and numbers of attacks per tree. This provenance variation in weevil attack was repeated in a clonal test which revealed that provenances which showed especially high resistance to weevil attack were also fast growing.

The resistance mechanism is not known, but preliminary work by Julie Brooks showed a slight (non-significant) difference in monoterpene levels between provenances of different resistance levels. The concept of using a multicomponent index to characterize resistant trees has been proposed utilizing monoterpene composition and feeding deterrency.

Kornelia Lewis, a Masters student at U.B.C. is studying the genetic variation among *P. strobi* populations in B.C. She is analyzing populations collected from Sitka spruce and the various species of interior spruce, such as Engelmann and White spruce. Another graduate student at U.B.C., B. Sieben, has created a spruce weevil hazard rating system based on heat sum accumulation. By calculating the heat sum in each of B.C.'s biogeoclimatic subzones, the potential for spruce weevil hazard could be predicted. He also investigated the potential for spruce weevil damage under climate change:

Percent of 17.4 million ha Prince George Forest Region in each hazard class[a]

| | Not Likely | Possible | Likely |
|---|---|---|---|
| Present Climate | 76 | 17 | 7 |
| 2.2$^{o}$ C warming | 16 | 13 | 71 |

[a] Three hazard classes were utilized: Not likely (<720 degree days), Possible (720-800 degree days), and Likely (>800 degree days).

The impact of *P. terminalis* on immature lodgepole pine is greatest in the dry, low elevation Interior Douglas-fir zone (IDF), where up to 31 and 17% of the annual height growth is lost in the first and second years, respectively. In the Montane spruce zone (MS) 25 and 14% of annual height growth is lost in the same two years. The cool, high-elevation Engelmann spruce-subalpine fir zone has the lowest hazard. As density decreses in the IDF and MS zones, the probability of individual stems being attacked by *P. terminalis* increases, leading to increasingly severe defect after attack.

## WORKSHOP SUMMARY: TECHNOLOGY TRANSFER

**Moderator: John W.E. Harris,** Forestry Canada, Victoria

Participants: 9

A definition of Technology Transfer was the "transfer of research results to the user in ways beyond publications and reports". Scientists tend to prefer to publish and then go on to new research rather than undertake additional efforts on past research such as workshops, poster and video presentations etc. Some client surveys, however, have shown that users prefer one-on-one field visits and workshops, and

particularly those involving the scientists who originated the technology.

At the Pacific Forestry Centre the Research Marketing and Services group bridges the comprehension gap (where it exists) between the scientist's publications and the general forestry community. It assists the scientist to apply specialized techinques i.e. licensing and patenting, and may provide additional funding.

Licensing, for example, serves to encourage contracting companies to develop research techniques to the point where they can be used by the land managing foresters with a minimum of effort. Introducing a charge for a product through licensing also tends to focus interest in the system. The BOD (business opportunity document) is a guide for documentation for a potentail license. The BOD includes details of the technology and the proposed service, an estimate of markets and something on investment and payback.

Too much long term dependence on government should be avoided. Ideally, a program should be scheduled so that the process becomes self supporting sfter several years.

A new initiative just getting underway in B.C. is the Model Forest Program, where several are to be selected from across Canada in mid-summer 1992. There may be 2 or 3 in B.C.; they will serve as large (100,000 hectares+) test and demonstration areas for good forestry practices and stress partnership between all those involved.

One disadvantage of having a separate Technology Transfer group at a research establishment is that it may insulate the scientists form the users. However, if the procedures are well designed this will not be the case, but such a group will in fact enhance contact between scientist and user.

A measure of TT could be a peer group evaluation. Also, client feedback could be instituted. One group uses TT awards as encouragement. Measures could be persons contacted and/or persons trained. There needs to be feed back to management relative to costs and profits and this information should also be available to the scientists and development people. A market assessment is usually desirable.

In the U.S. National forests, the Forest Pest Management (FPM) staff form a bridge between research station and National Forest staff, and also State and company foresters. FPM helps move research into the application phase with assistance from the scientists. The Methods Application Group (MAG) of the USFS seeks creative ways to transfer research technology.

**WORKSHOP SUMMARY: FOREST HEALTH/QUARANTINE ISSUES**

**Moderator: L. Humble**, Forestry Canada, Victoria

Participants: About 15

Lee Humble introduced the topic by noting that quarantine legislation has historically been the responsibility of Departments of Agriculture. In Canada, the majority of regulated insect species are of agricultural importance. He raised the question: Is the forestry community well served by existing quarantine legislation?

Examples of past introductions or interceptions of exotic species were presented as examples of some quarantine issues and concerns. Exotic introductions into B.C., discovered only after they were well established, include a species of *Clepsis* (feeding on conifer seedlings) and a European phylloxeran, *Phylloxera* sp. nr. *glabra* (attacking Garry oak). Sources of exotic introductions include packing and crating (dunnage) and nursery stock, etc. Quarantine regulations are generally designed to prevent international movement of pest species. Few, if any, restrictions are placed on the movements of insects within the country. Movement of native species to areas outside of their natural range can also result in forest health problems (e.g movement of hemlock woolly adelgid from western to eastern North America). Participants were asked to consider both domestic and international quarantine issues as they relate to forest health in their discussions.

Jon Bell discussed the Federal Plant Quarantine Act. Its primary aim is to prevent the introduction of dangerous pests. Phytosanitary certificates from the country of origin are required for the movement of goods which could potentially harbor pests known to be of quarantine significance. Products are also subject to inspection upon arrival, however, manpower limitations prevent the inspection of all imports. Quarantine regulations are now being based on Risk Assessment for specific pests. He noted that the increasing volume of international trade and the rapidity with which the goods can be transported has increased the risk of unwanted pest movements. Additional introductions are unavoidable and most will occur in urban areas. Is prevention worth the effort? Jon also raised the issue of raw log imports, noting that as timber shortfalls increase, so will the need for log imports. At the present time, import of logs with bark on is prohibited from temperate countries.

Jesse Logan noted that there is a need for quarantine strategies (e.g. the develpment of mitigating measures) which

do not create barriers to economics and trade. Prohibition of trade is not likely to be successful. Milt Holmes stated that the development of a North American free trade agreement will eventually result in the harmonization of quarantine regulations. In the future stronger justifications will be needed for pest risk assessments.

With the development increasing world trade the risk of unwanted introductions cannot be eliminated, therefore measures should be developed which reduce the risk. Education is needed to allow individual recognition of the seriousness of the intentional or unintentional movement of exotic insects.

## WORKSHOP SUMMARY: HISTORCAL RECORDS VERSUS CLIMATE CHANGE

**Moderator: J. Volney**, Forestry Canada, Edmonton

Periods over which climate change is readily detectable extend beyond the careers of most scientists. Historical records and proxy data offer opportunities to analyze the responses of insect populations over the long-term. However, historical records on forest insect populations in North America are limited to periods which seldom extend beyond 50 years. Anectodal and written proxy record, which may be found in sources such as the records of the Hudson's Bay Company, may extend the record back to the late 1700's. Recent work by Dr. Swetnam, in the southwestern United States, using dendrochronological techniques, reconstructs the western spruce budworm outbreak history as far back as the XIIIth century. Over this period there is considerable change in the climate and the reaction of insect populations to this change.

Dr. L. Safranyik opened with a presentation of the likely responses of insect populations to changes of climate. These responses include: range expansion or range contraction depending on the specific change in climate experienced and the populations involved. To be predictable, these reactions rely on a considerable knowledge of the population ecology of the insects concerned. Information on the mountain pine beetle was used to demonstrate these points. The northern limit of the areas where outbreaks are likely to occur depends on the location of the -40$^{o}$ C minimum temperature isotherm.

Dr. J. Borden followed with a description of the biology of the two pathogens which appear to react quite differently. The first of these is the pathogen *Phytophthora cinnamomi* which is a pathogen of some species. However, with a change in the patterns of precipitation this organism could become

an increasingly un-important as a root pathogen of weeds in regenerated forests. The pinewood nematode, by contrast, reacts to temperatures. Although the pinewood nematode is distributed throughout North America, it does not seem to be pathogenic in much of Canada. It is pathogenic further south: the change of behaviour occurring at the 20° C July mean maximum isotherm.

The frequency of jack pine budworm outbreaks were described by Dr. J. Volney. Over the past 50 years the frequency of outbreaks, as indicated by the extent of defoliation, has remained constant at one every 10 years. The size of the area damaged is correlated to the size of the area burned in the preceding years. This area is an indication of the severity of drought in the region. Over the range of conditions experienced in the prairie provinces, the frequency of outbreaks has not increased despite an exponential increase in the size of outbreaks in the past 50 years.

The workshop concluded with a request by Dr. A. Berryman to investigate all long-term data sets on population surveys using time series methods. These methods provide a means of indicating the causes of changes in the dynamics of populations.

## WORKSHOP SUMMARY: USE OF ANTIAGGREGANTS FOR BARK BEETLES

**Moderator: Skeeter Werner**, USFS, Fairbanks

Participants: Gene Amman, Ed Holsten, Ladd Livingston, Bill Upton, John Wenz

**Mountain Pine Beetle.** Verbenone, released in bubblecaps, was used to prevent lodgepole and ponderosa pine stands form attack by MPB in Idaho and Montana. Percentage of infested lodgepole pine declined with increasing numbers of verbenone bubblecaps up to 40 per acre; however, the number of infested trees increased with 68 bubblecaps per acre. Beetle behaviour is thought to alter at the higher dosage rate. Verbenone did not reduce MPB infestation in ponderosa pine stands when tested at the same dosages as in lodgepole pine. Again, beetle behavior appeared to differ between lodgepole and ponderosa pine at the levels of infestation which occurred during the field trials. The results from these tests indicate that verbenone appears to interfere with the aggregation behavior of MPB populations and prevents them from reaching high levels in high-value stands.

**Spruce Beetle.** Field evaluations of controlled release formaulations of MCH to prevent spruce beetle attacks has been underway in south-central Alaska since 1976. Bubblecaps and plastic bead formaulations have proven unsuccessful because they have been formulated to release at 20° C and do not elute sufficiently because average daily temperatures seldom reach 20° C during beetle flight which is initiated at 15° C. Aerial and ground applications of beads in 1991 did not deter SB attacks in felled right-of-way slash. Membrane composition and/or thickness of bubblecaps and plastic beads must be changed in order to increase elution rate.

**Douglas-fir Beetle.** A pilot control project was organized by the Idaho Department of Lands and the US Forest Service to treat a large volume of windthrown Douglas-fir with MCH plastic beads to prevent infestation by the DFB. A controlled release formulation (2%) plastic beads was applied at 4 lbs per acre from a modified seed spreader suspended from a helicopter. Results compared the number of beetle attacks per windthrown tree in treated and untreated plots. The treatment reduced the number of DFB attacks by 95.4%.

**Pine Engraver Beetle.** A field test was conducted in 1991 in northern and southern Idaho and in Montana to determine the efficacy of ipsenol and verbenone in preventing attack of ponderosa pine slash by the PE. The application consisted of 0.85 and 0.05 g/m2 for verbenone and ipsenol loaded plastic beads, respectively. The number of PE attacks were reduced as follows: north Idaho 64%, south Idaho 55%, and Montana 34%.

**Southern Pine Beetle.** An evaluation of inhibitor-based tactics have been tested to suppress SPB infestations. The spread of SPB infested spots was hastened by combining verbenone treatment with felling freshly-attacked trees within the spot, and verbenone combined with felling all infested tree. The verbenone was released from polyethylene bags using different elution rates.

**Western Pine Beetle.** Various enantiomeric blends of verbenone inhibit the attractive response of WPB to funnel traps baited with WPB pheromone. A 50/50 and (-)97(+)3 percent blends are most effective in interrupting the attractiveness of the WPB bait.

**WORKSHOP SUMMARY: GYPSY MOTH - ERADICATION OR SUPPRESSION**

**Moderator: Allan Van Sickle,** Forestry Canada, Victoria

Participants: 40; about half were vocal

To introduce the topic, recent successful eradication efforts in B.C., Oregon and Idaho were reviewed. By contrast, suppression activities in 1990 totaled 34,000 ha of an established infestation greater than 100,000 ha in Ontario and Quebec and 1.5 million acres within 7.3 million acres infested in eastern USA.

Group discussion then filled the workshop time, mostly covering three general topics VIZ public involvement, eradication/suppression experiences and possible alternatives.

Public acceptance of control efforts was seen to vary from general acceptance in semi-rural populations to greater questioning among urban populations. Early public involvement with the decision and an understanding of the problem was considered important. Experienced public communicators should be involved and backed up by the scientific specialists.

A pre-eradication control state involving actions aimed at preventing introduction was considered essential. While it was suggested that there are dozens, if not more, examples of successful eradications, the public amay perceive some as failures. It must be carefully explained that re-introductions can be expected and that edge populations may become evident if the full extent of a population is not clearly known and delimited at the outset. Some earlier efforts may have apparently failed due to weather, or earlier and poorer formulations or products of choice.

Sterile male programs were considered only as a possible suppression tool because of problems with rearing, calculating the flooding ratios and the possibility of sustaining +25% defoliation. The lack of an efficient monitoring tool makes it hard to evaluate confusion and trapping-out programs. Discrete populations in parts of Ontario could be a good opportunity for trials, but it was felt that western conditions warranted effective eradication programs and could not risk less proven or suppression efforts.

**WORKSHOP SUMMARY: SURVEY AND DETECTION TECHNIQUES**

**Moderator: Ken Gibson,** US Forest Service, Missoula

Participants: 27

The following presentations related work with various survey and detection techniques. Efforts varied from pheromone-baited "sticky" traps to latest "high-tech" aerial-video equipmnet. As with most other aspects of forest entomology, survey and detection methods are changing rapidly. A great challenge in the future will be striving to keep up with latest developments.

Chris Niwa: Described using tip moth pheromones to identify unknown species causing damage in ponderosa pine stands in eastern Montana. Identification of those species, and determination of pheromone complexes may be useful in developing management strategies. Also discussed work with western Forest Service (US) Regions in evaluating WSBW male-moth catches in pheromone traps as a means of predicting following year's defoliation. Also described ongoing evaluations of adult seed chalcid attraction to sticky panels of different colors. Hopeful of correlating trapped adults with subsequent seed damage.

Larry Stipe: Described ongoing evaluations in WSBW-infested areas in central Montana. Has been testing pheromone traps, capturing male moths, as a tool to help predict nest year's defoliation. Preliminary results are promising. High correlation between trap catches and subsequent larval populations. Now looking at trap catches and next-year defoliation. Data suggests adult male catches may accurately predict damage the following year. If so, costly egg-mass surveys could be replaced with pheromone trap evaluations.

Steve Munson: Discussed trapping techniques used in Utah to detect and delimit gypsy moth populations. Pheromone trapping is used in four distinct ways: delimitation and detection of known populations, with insecticidal treatments as a population-reduction tool, and as means of discovering "move-in" populations. Trapping efforts have shown the past treatments were successful. Steve also described an evaluation of aerial video technology for assessing pest populations. Though it has limitations, it can be useful on project level. He believes it will not replace aerial sketch-mapping surveys.

Bernie Raimo: Followed Steve's report on aerial video usage and seconded most conclusions with first-hand experience. Have used video cameras to aerially evaluate MPB treatments in Colorado. Pleased with camera operation and video

quality, but problems were encountered in locating, on the ground, aerially-photographed plots. Will be further evaluations in 1992.

Steve Burke: Described development of "Lindgren Funnel Trap" and use as a beetle detection tool. Traps use a variety of beetle pheromones and host volatiles to produce an effective beetle-attracting tool. Funnel traps are used to monitor beetle populations for research, population estimates, timing of log-haul bans, collection, and mass trapping to reduce pest-caused damage.

Ron Billings: Detailed population estimation technique, using funnel traps, in which SPB populations are compared with trapped populations of predators (clerids) to identify potential SPB outbreaks. Traps are used year-round throughout the South to monitor SPB infestations. Trap catches during the spring (coinciding with dogwood bloom) seem to be best predictors of current-year populations.

## WORKSHOP SUMMARY: FOREST HEALTH AND NON-TIMBER VALUES

**Moderator: John Dale,** US Forest Service, San Francisco

Participants: 25

Dr. T. Torgersen opened the session with a presentation on some of his work with parasites and predators of western spruce budworm and Douglas-fir tussock moth. He discussed the beneficial effects of birds, ants, spiders, and parasites as regulators of budworm and tussock moth. The dominant bird and ant species are all dead-wood-dependent. Dead wood, both as snags and down logs, was prominently mentioned as a critical structural component in maintaining populations of beneficial natural enemies and fostering forest health.

The foreword and preface of a new book, "Birds and Forestry", was passed out as an example of new literature on how non-timber values can be integrated into forest management. A second handout presented several implications of the changes taking place in the Timber Management Program of the National Forest System.

- Reduced timber harvest level by 30 to 40% from FY-91 levels
- Reduced Trust Fund collections for KV and BD by 35-40% from 1990 levels
- Reduced need for artificial reforestation of harvest areas
- Reduced size of Forest Service tree nurseries
- Increased forest health problems
- Reduced need for TSI for timber production

- Require amendments and revision to many forest plans
- Requires the right-sizing of the organization at all levels
- Shifts of GA and other fixed cost assessments to other resources
- Shift in the technical skills needed to support forest management
- Silviculture will increase support to other resources
- Increased conflict and management opportunities between adjacent ownerships
- More emphasis on the quality of resource management
- More emphasis on ecosystem management
- More emphasis on economically efficient commodity production
- More emphasis on forest health maintenance through silviculture

The purpose of the list was to stimulate discussion of the relationship between forest health and the new emphasis on non-timber values, and what this new situation means for forest entomologists and pathologists, who should be actively participating in developing the concepts involved in forest health. We are going to have to maintain old lines of communication, but also reach out to new audiences; audiences such as ID teams and wildlife biologists. This is not happening often enough in many regions. Such interacions are two-way streets, where all learn and benefit.

A good closing was the statement, "We (entomologists) are more than problems and Pests."

**PANEL SUMMARY: BIODIVERSITY/SUSTAINABLE ECOSYSTEMS**

**Moderator: Iral Ragenovich,** US Forest Service, Portland

Participants: All

Ecosystems are complex and dynamic, and therefore, often unpredictable. The processes within ecosystems are interdependent. Too often, as entomologists or land managers, our understanding of the interrelationships in an ecosystem is at a very independent, functional level of practicing knowledge. We are only just beginning to practice and understand the meaning of interdependence, whether we are referring to ecosystems, our relationship with them, or even our participation on interdisciplinary teams attempting to manage them.

We need to move from our traditionally functional philosophies of the past several decades (which in the case

of entomologists is the focus on the insect and how it relates to it's environment) toward a more holistic view that blends knowledge, technology, human needs, and ecosystem sustainability into meaningful management approaches. How do we get there? What broad concepts apply to ecosystem management? What are the relationships of insects and diseases to ecosystems and ecosystem disturbances? How do we incorporate ecosystem sustainability into planning?

## Some Philosophies on Ecosystems

**Dr. Tom Atzet,** Ecologist, USFS, Siskyou National Forest

Our views of ecosystem processes are biased by our beliefs, and relying on these beliefs tends to short circuit our thinking. We need to look at things in a different way. For instance we need to look at insects as part of the ecosystem and deal with them all the time - not just when they become a pest.

Disturbance, a fundamental ecosystem process, has its regime defined by: intensity, frequency, extent and juxtaposition. Each regime has it's own personality and signature, and should be treated as such. Common agents of disturbance, such as fire, erosion, wind, animals (insects), disease, and weather extremes all have their own unique effect on the ecosystems; but they all exert a change in the system.

Change provides the stress essential for evolution and adaptation. Stress processes are important at a population level. Change is essential to the ecosystem process, and change through disturbance adds a chaotic element which results in diversity. However, change though disturbance is not acceptable to humans. We are okay with a gradual rate of change, but where it occurs all at once it is considered catastrophic. Catastrophic is a value judgement. Stability is considered "good" by humans, not by nature. If we want "forest health" we cannot eliminate stress because nature needs stress to develop systems. Humans tend to want to dampen oscillations; but this may actually make oscillations more intense when they do occur.

Natural processes contain an essential wisdom - Change. Humans want stability, when what we should be managing is change. For instance, we need all age classes in a system, and disturbance is what keeps things cycling and ensures a diversity of age classes. Limits are universal to all organisms. When these limits are removed, then the change that eventually occurs is much bigger than it would have been otherwise. Disturbances, such as fire, often create these limits. Frequent ground fires impose a limit on vegetation in a system, and can result in less diversity. If this limit

is removed, and frequent ground fires are eliminated, then when the change does occur, it is bigger, and more catastrophic than it would have been otherwise.

We need to continually examine our beliefs by thinking.

## Relationships of Pests to Other Ecosystem Disturbances

**Dr. Al Harvey, USFS,** Intermountain Forest & Range Exp. Stn.

Pests participate in ecosystem development and function in a wide variety of ways, depending on the nature of the system. For example, consider the comparison between Inland and Coastal forests.

| Coastal | Inland |
|---|---|
| Low fire frequency | High fire frequency |
| Biodecay dominates (pathogens replace fire) | Physical (fire) dominates |
| Well buffered - temp/moist stable | Poorly buffered (changes in temp/moist often extreme |
| Terrain moderate | Terrain diverse |
| Vegetation community large and old | Vegetation community small and young |
| Relatively fertile soils | Relatively infertile soils |
| Nutrient turnover high | Nutrient turnover low |
| Low stress | High stress |
| Low mortality | High mortality |

In both, but particularly in Inland type systems, there are critical functions (needs) that allow for long-term stability.

1) Because of fire, there is a need for environmental, as well as gene-based resistance.
2) There is an inherent need for biological recycling power.
3) There is a need for genetic compromises and rapid change.

Natural disturbances to which forest ecosystems must react (adapt) include glaciation, volcanic deposition, climatic events, natural wildfire, pest arrival/loss/change. Human-caused disturbances include introduction of insects and diseases, alterations of tree species, and fire cause and control. Each has varying geographical and temporal characteristics. Ecosystems successfully cope with most (not all), though the time line is slow with regard to human desires.

There are parallels between what happens with insects and diseases and what happens with fire. They cause many of the same things. Like fire, pests are a part of the ecosystem and function within it. Insects and diseases serve as agents for change (nutrient recycling and genetic selection). They may be cause or symptom of disturbance! The bottom line may be loss or gain, of either productivity or sustainability. Sometimes a tradeoff between them.

Some interesting (required) ecosystem characteristics:
- sustainability is dynamic (sameness not required)
- protect vegetation/other resources (protection of broad gene pools)
- ability to adapt rapidly (flexibility)
- buffer against rapid change (diverse in character, species, genes, age, etc.)
- carbon and nutrient stores and turnover adequate

Even with all these characteristics, neither native nor managed systems are always sustainable in any specific form.

Insects and disease set the stage for recycling and aid in rapid and appropriate adaptation. An alternative view to native insects and diseases is that insects and diseases are active solutions to a system problem. This does not imply that a diseased forest is a healthy forest or that you don't have to control pests.

We need to look at where the system is and manage to:
- protect site resources
- be conservative
- not base future productivity on "no loss" to pest activity assumptions
- be aware of temporal and geographic variation
- emulate natural systems

Diversity is part and parcel of forest health. No...insect and disease activity isn't always healthy (but may often be in the long run)! Biodiversity is a key to flexibility. Forest ecosystems must by flexible to be sustainable.

## Ecosystem Sustainability and Planning

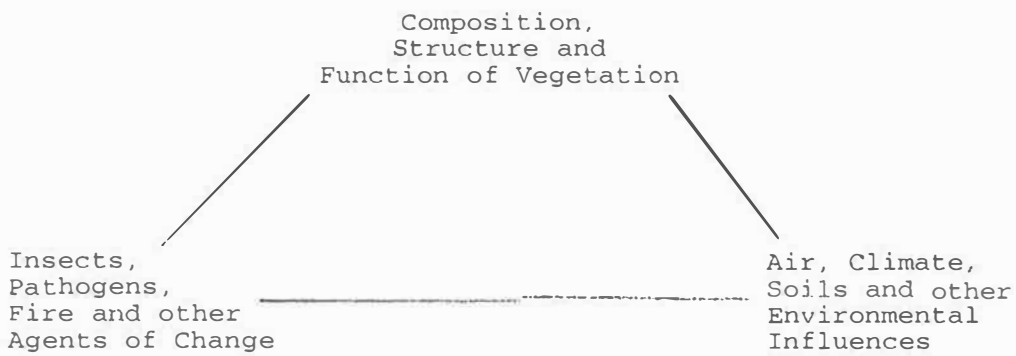
**Jim Byler**, Supervisory Plant Pathologist, USFS,
Forest Pest Management, Northern Region.

Forestry is undergoing a fundamental change. The change is the result of an on-going controversy, a controversy not only about methods, but about values. Concern for the environment is an entrenched value. Biodiversity and ecosystem sustainability, for example, are now management objectives. The Northern Region has developed a new approach to forest planning which changes the emphasis from products to processes. The approach is to manage for Sustainable Ecological Systems. Only by managing for sustainable ecosystems can continued resource production by sustained. The concept also gives greater emphasis to the landscape scale and to the longer term.

Considerations for a Desired Future Condition:

- The variability of natural ecosystems will be used in the development of desired future conditions, but past conditions are not the same as desired future conditions.
- Resource production is still a part of planning.
- Emphasis is on sustaining systems, not on increasing production.
- Insects and pathogens are seen not only as "pests" but their other ecosystem functions are also recognized (influence on succession, decomposition and nutrient recycling, food and habitat for wildlife, effects on evolution, etc.).
- Roles of insects and diseases are considered in terms of their variability and effects in natural ecosystems.
- Forest health will be sustained, in part, by restoring and maintaining the roles, effects and abundance of insects and pathogens within limits set by co-evolution of these agents in their natural ecosystems.

Forest Health Triangle: forest health might be viewed as the equilibrium between insects, pathogens (and other agents of change) and forest vegetation in their environment.



We all recognize that many forests are unhealthy. Fire control, some past cutting practices, the introduction of exotic pathogens and insects, and other things have brought about a major shift in forest composition, structure and density. Many of our severe insect and disease outbreaks are symptoms of those changes, changes that have put the forests at risk.

The "white pine forests" of northern Idaho illustrate a changed forest and unhealthy ecosystem. Partial cutting, fire control and the effects of the introduced blister rust fungus have reduced the white pine composition of those mixed conifer forests from about 50 percent to about 5 percent. Douglas-fir was increased by nearly the same magnitude. Native root pathogens reacted to the change. They once removed Douglas-fir from the mixed species stands, favoring the release of white pine and larch. They have become severely damaging pests now that Douglas-fir is the predominant species.

The Forest Insect and Disease Community has recognized the need to shift from an emphasis on the pest to an emphasis on the Forest. We still need to give more emphasis to changing forest conditions of risk. But we also need to make a more fundamental change, and the new emphasis on managing for sustainable ecosystems offers us a format for the change. We need to broaden our scope to the landscape scale. We have focused on changing stand conditions, and failed to recognize the extent of insect and disease caused landscape changes. We need to give more attention to the long term. Some of the most significant vegetation changes and pest outbreaks have taken decades to develop, but we have failed to monitor these changes and fail to recognize their implications. And, perhaps most significantly, we need to recognize the beneficial roles of insects and pathogens. Managing for sustainable ecosystems. If it is to succeed, must include an understanding of the many roles of insects and pathogens in ecosystem processes, and must maintain those roles through the management process.

## WORKSHOP SUMMARY: SCOLYTID STRATEGIES - DIRECT CONTROL OF BARK BEETLES

**Moderator: Dan Miller,** PheroTech Inc., Vancouver

Participant: 45

Four members presented information on the direct control of five different species of bark beetles, all in the genus *Dendroctonus*. Ron Billings discussed the successful use of

the cut-and-leave tactic to control southern pine beetle. The rapid spread of southern pine infestations during a single year has warranted the use of fast direct controls. Julie Weatherbie presented data on the use of pesticides to control western pine beetle. Results obtained by Jim Hoffman and Ralph Thier show that several formulations of esfenvalerate are as good or better than the use of carbaryl for three years of protection from a single application. During the past seven years, MSMA has been extensively used to control mountain pine beetle in the Merritt Forest District in British Columbia. Tom Lacey reported that the use of MSMA was the prime factor for the current infestation area of 2,600 ha. This compares favorable with the predicted area of 62,000 ha if MSMA had not been used. Robert Hodgkinson filled the remaining time of the workshop by discussing the use of trap trees to control spruce beetle, with specific details on the logistics and applications. Bob also discussed the use of lethal trap trees with reference to spruce beetle, mountain pine beetle and Douglas-fir beetle.

## WORKSHOP SUMMARY: CONE AND SEED INSECTS

**Moderator: Don Summers**, B.C. Ministry of Forests

This workshop was an informal, general discussion on projects that are under way or planned by participants and/or their organizations.

Nancy Rappaport began with an outline of some USDA-FS work on seed chalcid in Douglas-fir. In cooperation with Chris Niwa, she is investigating the impact of *Megastigmus spermatrophus* on Douglas-fir seed crops and how the development of the chalcid in unfertilized seed might affect measures of the impact. Studies on insect competition in cones suggest that the chalcid can be displaced by the Douglas-fir cone gall midge (*Contarinia oregonensis*). This may also affect the assessment of chalcid damage in infested cones. Chris Niwa's yellow sticky trap trials suggest a correlation of trap catch and damage for the seed chalcid. The effect of host volatiles on chalcid behavior is also being investigated.

Nancy also reported that Pat Shea has been working with cone and seed pests in rust resistant white pine and in sugar pine. *Leptoglossus* appears to be a major pest in both species and a *Eucosma* species is also important on sugar pine. Biological control techniques are being used to assess causes of abortion of sugar pine cones. It is also being used to measure the impact of *Megastigmus albifrons* in ponderosa pine.

Insect attractant work in the USDA-FS includes work on the pine cone beetle and *Dioryctria*. Marian Page and Gary Grant will be cooperating on the *Dioryctria* project and will look at correlating cuticular hydrocarbon analyses with males captured in traps containing female pheromone glands. This could be used to clarify some of the taxonomic questions in the genus *Dioryctria*.

Roger Sandquist reported on cooperative work with Tim Schowalter that will look at the use of heat to control overwintering seed chalcids and Douglas-fir cone gall midge in the soil duff.

John Stein mentioned several studies, including seedbug exclusion, residue profiles for systemic insecticides in ponderosa pine, damage assessment for Douglas-fir cone gall midge and the effects of implants on grafts. The economics of individual tree protection from cone and seed insects is being looked at for both Douglas-fir and white fir. For Douglas-fir, studies are showing that in natural stands, cone moths are the main problem and gall midge, seed chalcid and seedbug damage is low. Damage can be up to 76% (68% of that due to cone moths). Acephate implants provided the best control in a comparison test with carbofuran and dimethoate against these insects. In seed orchards, gall midge is the number one problem and while acephate reduced damage in trials, there was no increase in filled seed. This affects the economics of protecting the cones.

Life table studies for ponderosa pine cones are being carried out over several cone cycles. So far, the major pest are cone beetles and *Dioryctria* on second year cones. There is high variability.

Chris Niwa, in addition to work on seed chalcid, reported on work with coneworm pheromones. The pheromone for *Dioryctria disclusa* was tested in mating disruption trials in cooperation with Drs DeBarr and Barber. Despite some problems, they had some success in reducing trap catch with that material. The attractant for *D. abietivorella* has not been all that successful and work has been put on hold for that project.

John Borden (SFU) outlined trials planned by Marian Sawchuck using neem against the green spruce aphid and spruce gall aphid. Both foliar and soil drench applications will be made on potted spruce and field tests will follow. Another student may be looking at the chemical ecology of the seedbug next year.

Don Summers commented on several other cooperative projects with SFU and it's alumni. Calibration tests with the Douglas-fir cone moth (*Barbara colfaxiana*) attractant in 1990, by Malcolm Smith, had mixed results. This appeared to be due to the influence of cone crop size on the results. The BCMF is hoping to carry on with the calibration through contract in 1992. Other projects planned include testing various strains of nematodes against the Douglas-fir cone gall midge and spruce cone maggot (*Strobilomyia neanthracina*).

Other BCMF projects include cooperative work on the development of damage prediction sampling plans and control measures for spruce cone maggot and western redcedar cone midge (*Mayetiola thuja*). Damage assessment and life history work may begin on a *Trisetacus* mite that destroyed 80% of the yellow cedar pollen crop in one orchard in 1990-91.

Metasystox-R was recently registered in Canada for cone and seed insect control. It is now available for use as an injection on Douglas-fir and spruce and as a spray on Douglas-fir, spruce and western redcedar. The first operational use of the injection method occurred in 1991.

Pests that reduce tree vigor, such as gall aphids, defoliators and mites are also of concern in B.C. orchards. A project began in 1990 to survey for and identify natural enemies of these pests that occur in the orchards. The goal will be to try to integrate these beneficial insects into an overall orchard pest management plan. This project is being carried out with the assistance of students in the cooperative education programs at 2 universities

In general discussion there was some concern expressed about the potential loss of specific chemical controls due to the pesticide re-registration processes that are under way in the USA and Canada. Pesticides with minor uses such as seed orchards, may not generate the profits necessary to pay for the additional testing required for continued registration. This situation is not exclusive to pesticides now used in seed orchard pest control and may also be a problem with semiochemicals coming on line. This situation will have to be addressed in the near future.

**WORKSHOP SUMMARY: BIOCONTROL PRESENTATIONS - GETTING THE MESSAGE ACROSS WITH VIDEO**

**Moderator: M. Hulme**, Forestry Canada, Victoria

Three videos presented by participants were shown to illustrate various aspects of video production. The focus of the discussion was on the essential elements needed to make a successful video, especially the purpose of the video (to educate, motivate, entertain etc.) and the intended target audience. Because video is so widely used in everyday life, and is probably the most powerful medium of mass communication, our videos must be carefully made if they are to compete successfully for audience attention (and possible action).

The videos shown were:

Natural Enemies of Forest Insects. 1988. Made by Forest and Range Sciences Laboratory, Pacific Northwest Experimental station, USDA Forest service, La Grande, Oregon; and Wallowa Valley Ranger District, Wallowa-Whitman National Forest USDA Forest Service, Joseph, Oregon. Approx. 25 mins. Presented by Dr. Torolf Torgersen.

Biological Control of the Winter Moth 1989. Made by Pacific Forestry Centre, Forestry Canada, Victoria. Approx. 15 mins. Presented by Dr. Imre Otvos.

Forest Insect and Disease Conditions, British Columbia and Yukon 1991. Made by Pacific Forestry Centre, Forestry Canada, Victoria. Approx. 15 mins. Presented by Dr. Allan Van Sickle.

**WORKSHOP SUMMARY: NEED FOR COORDINATION OF DEMONSTRATION AREAS**

**Moderator: Ken Gibson**, US Forest Service, Missoula

Participants: 12

Data collected from demonstration areas have led to the development of management recommendations for a variety of forest pests. There is continuing need for development, maintenance and protection of these areas. Coordination between agencies--state (province), federal and private--is mandatory if data collected from such areas are to be meaningful and useful to resource managers.

Gene Amman: As a coordinated effort between research and pest management, replicated areas were established in lodgepole pine stands to measure the effect of partial cutting on resultant MPB-caused mortality. Installed on the Lolo and Kootenai NF's in northwest Montana, blocks were cut to either a lower diameter limit (7,10, or 12 inches dbh), or basal area reduction (80,100, or 120 sq ft/acre). Best results as measured by subsequent MBP-caused mortality--were obtained in the blocks of lower basal area reductions. Beetle-killed trees exceeded 90 percent in the uncut blocks; but an average 10 percent or less in 80 and 100 BA blocks. Sanitation thinning alternatives, for stands where regeneration is not an option, have been developed.

John Schmid: Similar studies were initiated in ponderosa pine stands in the Black Hills of South Dakota. There, effects of thinning on resultant growth rate and MPB depredations were measured. Stands were even aged (80-125 years). Growing stock level (roughly equivalent to basal area) was reduced to 60, 80, and 100 in the partial-cut blocks. Others received no treatment and remained at original stocking-approximately 128. Earlier studies had suggested the critical threshold for MPB was a GSL of 150. These areas have demonstrated that the threshol may, in fact, be 120. While thinning effects may vary with site index, managers should consider the increased risk of unacceptably-high MPB-caused mortality in second-growth ponderosa pine stands at densities exceeding 120 square feet of basal area (when trees exceed 8 inches dbh).

Larry Stipe: In 1981, silvicultural demonstration areas were established on the Gallatin NF in southwestern Montana to measure the effect of various harvesting techniques on populations of WSBW. The silvicultural strategies employed were: group selection, overstory removal, shelterwood, and clearcut. While the studies are ongoing, and conclusions regarding long-term treatment effects have not been reached, interim data shows budworm populations have increased in most treated areas. Impacts on growth rates and/or mortality have not been measured. Though limited in scope, these areas suggest additional studies are needed to see if these trends are consistent.

Dayle Bennett: Additional WSBW demonstration areas were established in 1980 on the Carson NF in New Mexico. Blocks were cut in 1980, initial population data collected in 1981. A major population increase occurred that year, followed by a general population collapse in 1983. To date, no statistically meaningful data has been collected from the blocks. They continue to be monitored. There is a need for greater commitment and coordination when establishing and maintaining demonstration areas.

Dave Bridgwater: Described a set of thinning plots established in 1967 in eastern Oregon ponderosa pine stands. Plots are still being maintained and quite a lot of good data has been collected from them in the intervening years. That data has resulted in management recommendations for second-growth ponderosa pine, to reduce mortality caused by MPB, in the Northwest.

**WORKSHOP SUMMARY: ASIAN STRAIN OF GYPSY MOTH - CONCERNS AND DISCUSSION**

**Moderator: Peter M. Hall**, BC Forest Service, Victoria

Participants: Approximately 150 in attendance

The Asian strain of Gypsy Moth was introduced into the Vancouver, B.C. area in the summer of 1991 and was also detected in and around Tacoma in Washington State and Portland, Oregon. The introductions came from grain ships originating from infested ports in Eastern Russia.

These introductions represent the first introductions of this insect to continental North America. A total of 33 male moths (most of which were the Asian strain) were caught in Vancouver; 9 males were caught in Tacoma; and, one male moth was caught in Portland.

The Asian strain of Gypsy Moth represents a greater threat to the Pacific Northwest than the North American or European strain as the female is capable of strong flight, the larvae have a wider preferred host range including coniferous tree species, the insect is likely more cold hardy, and the female can lay up to 1200 eggs per egg mass. A recent risk assessment carried out by the US Forest Service estimated that this insect could spread throughout the Pacific Northwest within 20 years and could result in billions of dollars in cumulative control costs, resource losses, and quarantine costs.

In response, eradication programs have been proposed by both American and Canadian agencies. In each country, the eradication treatment is comprised of up to 3 aerial applications of B.t.k. at a rate of 50 BIU per hectare to fairly broad residential and industrial areas and repeated ground application in and around positive trap catch sites.

In B.C., approximately 18 500 ha will be aerially treated by DC-6 fixed wing aircraft. In the U.S., all treatments will be by rotary wing: approximately 56 000 ha in Tacoma; and, about 4 000 ha in Portland. A declaration of an emergency

situation is expected to be declared by the U.S. Secretary of Agriculture; as of March 5, 1992, no emergency has been declared by provincial or federal Canadian agencies.

Estimated costs of the eradication projects are $25 million (US) for the American program which includes increased detection and delimitation trapping in western and south eastern port areas. The Canadian program is estimated to cost about $5.3 million (CAN). In both jurisdictions, programs will be cost shared by federal and local agencies.

An expanded inspection of ships will also be implemented to restrict or limit further introductions.

Dr. Bill Walner (USFS) presented a video on the Asian Gypsy Moth that is now available from the USFS. The video describes the geographic range of the Asian strain and discusses the important differences between this and the more familiar North American strain.

There was a good amount of discussion regarding these proposals. In general, it was felt that the proposed treatments were a reasonable response to the introductions.

Further research would be required to evaluate a variety of aspects relating to Asian Gypsy Moth to refine the ability to carry out risk assessments and to plan more biologically stringent control programs. These issues include:

- actual male and female dispersal patterns
- host preferences of the Asian strain
- pheromone specificity for Asian Gypsy Moth
- result of interbreeding with North American bio-types
- egg hatch and larval development temperature needs
- treatments to be carried out at the source to reduce the level of infestations on shipping.

It was also pointed out that the Asian Gypsy Moth may not be the most dangerous insect pest that could be introduced into North America by importations from Asia. Other insects, notably the Nun moth could constitute an even greater threat to commercial coniferous forests.

**WORKSHOP SUMMARY: STRATEGIES FOR MOUNTAIN PINE BEETLE MANAGEMENT**

**Moderator: Peter M. Hall,** BC Forest Service, Victoria

Participants: Approximately 50 in attendance

Mountain pine beetle continues to be one of the major pests of concern in western Canada and the United States. Recently, it has become apparent that there are alternate approaches to dealing with this insect ranging from programs utilizing direct control strategies to programs solely concerned with manipulation of stands for hazard reduction.

In British Columbia, a planning framework has been developed which should allow for consistent approaches to similar circumstances throughout the province. A number of strategies have been identified for application to the infestation status in a specified geographic area. Various treatments are applied within the management area at varying intensities of effort depending on the strategy selected.

A strategy is selected based on the infestation status and history, management objectives, and other resource values in the area. These general strategies include: 1) suppression; 2) maintaining a low population; 3) holding actions to prevent rapid increases; 4) salvage infested timber as possible; 5) abandon an area or do nothing; and, 6) prevention.

In Washington and Oregon, the emphasis has been on stand manipulation to minimize hazard and subsequent damage. Extensive areas, primarily in ponderosa pine, have been thinned or otherwise treated to reduce the hazard. This approach seems to have worked well in the areas selected. Other regions in the US have employed a variety of strategies depending on objectives and the resources at risk.

The application of specific strategies in different jurisdictions may be dictated by administrative differences. For instance, the use of attractant baits to restrict dispersal from cut blocks is only applicable if guarantees can be made that the block will be cut as scheduled. Failure to follow through in this regard will likely result in greater losses than would otherwise occur.

Further, the selection of the most appropriate approach is often dictated by logistical and/or budgetary constraints. Extensive programs of selective cutting may only be feasible where good access exists, or where aesthetic and timber values are high to counterbalance the costs.

There is no absolute correct management strategy. The approach taken must be determined by the specific circumstance and by the management objective.

## WORKSHOP SUMMARY: Future Research Priorities

**Moderator: Gordon Miller,** Forestry Canada, Victoria

Participants: Nancy Rapaport, Jill Wilson, Mike Geisler, John McLean, Jon Volney, Hal Weiser, Don Summers, John Hennigman, Les Safranyik, Mike Hulme

The discussion of the workshop was lively, in spite of the small number of participants. The discussion centered on two themes: current issues facing research and future priorities.

The current environment of research in forest entomology (and most other areas of research) was viewed as chaotic. Issues identified as impacting on entomological research included:

- fragmented funding which requires more time be spent on locating sources of funds and development of project proposals;
- a lack of vision for future directions in entomology (the discipline is viewed by some as passe) making it less attractive to decision makers allocating funds;
- lack of guidance on whose priorities (e.g., politicians, funding sources, clients) research should be addressing;
- complex advisory structures making it difficult to integrate advice which subsequently leads to frustration on the parts of both the advisors and scientists;
- the growing number of "publics" that scientists must interface with; and
- mixed messages given by senior managers on the priority of technology transfer (e.g., criteria for promotion are not in line with the expectations of managers).

These issues are slowing scientific progress or the application of developed technologies. In the current environment, entomologists (and other scientists) must be flexible in their approach to projects if they are to receive support, both moral and financial, for research proposals.

The top five priorities for future research were identified as (order of priority was not identified):

a) entomology in relation to non-timber values and the role of insects in ecosystem dynamics;

b) quantification of impacts on timber production;

c) decision support systems to assist resource managers in their decision making;

d) integrated approaches to pest management compatible with other forest management practices; and

e) development of environmentally acceptable pest control treatments.

With the except of (a), these have been acknowledged as priorities for several years.

With shrinking resources, it is important that research agencies collaborate as much as possible to allow for steady progress in the development of new and improved forest management technologies, of which forest pest management is one subset.

**WORKSHOP SUMMARY: DOUGLAS-FIR TUSSOCK MOTH MANAGEMENT**

**Moderator: Iral Ragenovich,** US Forest Service, Portland

Participants: 31

Suppression/Population Management Strategies: Three Douglas-fir tussock moth suppression and population management strategies have been employed in recent years. These include treating populations with the Douglas-fir tussock moth virus, treatment with the biological insecticide, *Bacillus thuringiensis*, and mating disruption through aerial application of the DFTM pheromone.

Two projects using DFTM virus were conducted in 1991; one in Kamloops, BC, and one in Idaho. In Kamloops, a total of 200 ha in three areas were treated. Average % mortality (corrected) for each of the treatments were: Virtuss (new formulation - 78.5, Virtuss (old formulation) - 83.9, and TM BioControl - 47.1. Predicted defoliation for these areas was moderate to severe bases on pheromone trapping. Actual defoliation was light to a trace.

Lab tests had indicated that the new formulation of processed virus was effective at one half the registered dose. A test rate study was done in Idaho to evaluate this. A larval sample taken 21 days after treatment showed no significant difference between treatments. Larval populations will be sampled again in 1992. In the past, frequent outbreaks have not occurred in this area, and there was evidence of virus in pretreatment populations.

There was a good discussion on the role of the virus in the ecosystem, and how introduction of the virus may effect the dynamics of the parasites over time. Model runs show that to establish a parasite/prey relationship you cannot have the virus in the system, because the virus kills the host for the parasites.

In Northeastern Oregon, Bt was used in a suppression project on 116,000 acres. There was a population reduction in all areas, including the check. Only 2% of the larvae collected and reared in the lab were infected with the virus.

Two projects (one in Idaho and one in British Columbia) were conducted to test mating disruption through aerial application of the Douglas-fir tussock moth pheromone. In BC, the pheromone was impregnated in PVC particles. This seemed to work fine, although the particles apparently do not hold up through the entire moth flight. In Idaho, the pheromone was applied in hollow fibres with a sticker. In the untreated area, 75% of the females produced egg masses, and in the treated area, 38% of the females produced egg masses. This represents a 50% reduction in reproduction. Larval sampling will be done again next summer.

Sampling: In California, cryptic shelters are used to predict population trends. Information collected from the shelters include: egg masses, cocoons, males and females, parasites, and emergence from eggs. Cryptic shelters are an inexpensive, easy to use, way to predict population trends, however, no specific action thresholds have yet been established.

In Oregon, scientists have developed a method of sampling cocoons. The incidence of cocoons per 1000 sq. cm. on lower crown foliage is determined. This is then converted to early larval density for the following year.

## WORKSHOP SUMMARY: EXPERT SYSTEMS/DECISION AIDS

**Moderator: Barbara J. Bentz,** U.S. Forest Service, Ogden

Participants: 20-25.

The context of the workshop was aimed at the user, the ergonomics of system design and development, and how the systems being developed fit into the broad gamut of forest management. Invited presenters were Patrice Janiga (USFS MAG), Keith Reynolds (USFS, PNW), and Lukas Schaub (VPI&SU).

Barbara Bentz presented the concepts of a mountain pine beetle advisory system being developed for use by silviculturists and FPM personnel. Questions relating to the appropriate faction (e.g. research, FPM, university) responsible for each part of system design, development, user interface development, and implementation were introduced and discussed. Also discussed were ideas concerning standardizing the user interface of systems being developed separately but targeted at similar users.

Recent advances in PC hardware and software technology have provided the opportunity for developers to create a new generation of decision support software for forest managers that is both more powerful and "user friendly" than expert system applications developed just a few years ago. The new systems being developed incorporate complementary decision-support components such as hypertext-based access to literature, literature retrieval, and report generators which can dramatically enhance the utility of a decision-making aid. An example of such a system is SBexpert, a knowledge-based system for spruce beetle management being developed by Keith Reynolds. This system takes advantage of new, sophisticated graphical user interfaces providing an informative yet interesting tool for managers to use. Keith suggests that system developers can encourage use and acceptance of knowledge-based systems by taking ergonomic considerations into account in system design.

Lukas Schaub gave an overview of GypsES, a computer-based environment that will provide forest managers with an integrated set of decision-making tools. GypsES assists managers in dealing with complex problems of gypsy moth control, resource allocation, and program implementation with state-of-the-art technologies including data base management systems, geographic information systems, knowledge based systems, and statistical and simulation models. Development of GypsES has transpired in several phases: 1) a prototype phase where users needs were elicited; 2) the prototype structure was implemented with functional components; 3) a graphical user interface was implemented in X-Windows; and

4) feedback from test sites is currently being incorporated. Lukas instigated continued discussion on the partition of development and implementation roles of Forest Service and university researchers and the pros and cons of relieving researchers from the time intensive user interface development.

Patrice Janiga talked about the development of INFORMS as a means of integrating insect and disease management information into field office planning. INFORMS, which is being developed by the Methods Application Group (MAG), is a set of automated tools designed to assist forest and district level users in integrated planning and analysis of complex resource management problems and alternatives. One of the leading goals of INFORMS is to provide a variety of software tools without the end user having to become an expert user of each package. Patrice emphasized the importance of "user driven" feedback in the continued refinement of developing technologies, and demonstrated examples from INFORMS where the user is being integrated into system design. The philosophy of MAG is to try to devise and support a "home" for scientific expertise which facilitates technology transfer of the expertise while minimizing the adverse impact software support has on insect and disease experts. This has important implications for researchers who are developing systems of this type.

## WORKSHOP SUMMARY: ISOLATION AND IDENTIFICATION OF SEMIOCHEMICALS

**Moderator: Dr. Gerhard Gries,** Simon Fraser University

Three presentations were given, two of them highlighting novel findings in bark beetle pheromone research, and one outlining technical procedures in moth pheromone research.

I) A case of interaction between optical and geometrical isomers in bark beetle pheromones. (A.D. Camacho, Simon Fraser University, Burnaby, BC).

Laboratory and field experiments disclosed that *Dryocoetes confusus* was strongly attracted to (+)-*exo*- and (+)-*endo*-brevicomin at a 9:1 ratio. A 1:1 ratio of the same compounds was inhibitory. Sympatric *D. affaber* was most strongly attracted to racemic *exo*- and (+)-*endo*-brevicomin at a 1:1 ratio. In conclusion, species-specificity of pheromone communication in sympatric *D. confusus* and *D. affaber* is imparted by specific ratios of both geometrical and optical isomers of brevicomin.

II) 1-Methylcyclo-hex-2-en-ol (MCOL): novel aggregation pheromone in *Dendroctonus rufipennis*. (H. Wieser, University of Calgary, Calgary, Alberta).

1988 - 1991 field experiments in Alaska, Alberta and British Columbia tested the effect of MCOL on the attraction of *D. rufipennis*. While addition of MCOL to the known semio-chemicals α-pinene and frontalin increased attraction up to 17 times in Alaska, there was no synergistic effect in BC. As MCOL is chiral, it was concluded that production of and response to MCOL enantiomers needs to be further investigated in geographically separated populations of *D. rufipennis*.

III) Techniques in moth pheromone research. (G. Griese, Simon Fraser University, Burnaby, BC). Four techniques employed in moth pheromone research were outlined:

1) Gas chromatographic-electroantennographic detection (GC-EAD).
2) Selection of specific detector species to increase selectivity and sensitivity of pheromone identification.
3) Retention index calculations of EAD-responses on gas chromatographic columns with different retention characteristics.
4) Microanalytical chemistry of pheromone gland extract to determine the functionality of EAD-active compounds.

**WORKSHOP SUMMARY: STAND STRUCTURES, POST OUTBREAK**

**Moderator: R.F. Shepherd,** Forestry Canada, Victoria (ret'd)

Participants: 30

The following questions, regarding stands attacked by spruce budworm, spruce beetle and mountain pine beetle, were addressed by Bruce Hostetler, Skeeter Werner and Terry Shore, respectively:

1. What change does the insect cause to the species composition and stand structure in the short or long term?

2. What are the normal successional changes of the stands and how does the insect change these?

3. Are certain trees preferentially attacked? What is their fate?

4. What are the ecological and economic characteristics of the stand after the outbreak has ceased?

5. What are the normal silvicultural practices and how are these changed? Can the stand be rehabilitated?

6. Is the stand changed to make it more or less susceptible to this or to other pests?

**WORKSHOP SUMMARY: Public Interaction and Participation**

**Moderator: M. Giesler,** B.C. Ministry of Forests, Victoria

The 3 speakers (L. Kline, Head of Forest Health, Oregon State: Don Dobson, local consultant and Pat Field, local politician) gave short presentations to a well attended workshop. Following is a summary of the presentations and discussions.

- **Public should be involved, they demand to be involved**
  - Partly because of a perception of past poor management.
  - The public wants to be an insider. They want to know that the scientist's values (and manager's values) are similar to theirs.
  - Public participation is an opportunity to do what is right, morally.
  - These are no urgent situations which preclude public participation.

- **Scientists and Technicians should participate in this debate.**
  - They must present facts and present them simply (digestible).
  - They must also provide simple interpretation of the facts.
  - Don't be afraid to express opinions but need to be clear about what is opinion and fact.
  - Need to be open about what we know and don't know.

- **Success results from:**
  - involving the public EARLY with no preconceived plans
  - beginning by listening to all alternative and excluding none
  - seeking input, go out into community (including local governments) and get input
  - listening! respect others values

- avoid taking positions before solutions are developed
- sincerity
- understanding that there is failure only if we don't learn form our mistakes
- not committing to anything you can't deliver
- identifying and understanding the objectives of all stake holders.

**WORKSHOP SUMMARY: History of Forest Entomology in the West**

**MODERATOR: Malcolm Furniss**

Participants: 18 (Billings, Berryman, Chong, Dale, Dewey, Flanagan, Gast, Gibson, Kohler, Macias, Niwa, Rappaport, Roettgering, E. Smith, Safranyik, Valenti, Wright)

The workshop began with self introductions and comments by each person concerning their interest in history. The center of interest sometimes involved an association with, or employment by, a prominent earlier forest entomologist. Correspondence, reports and photos also had stimulated the interest of many persons. Underlying everyone's interest was a deep personal respect for particular earlier forest entomologists (e.g. Hopkins, Burke, Miller, Keen, Richmond, etc.). An unexpected bonus was the presence of Kenneth H. Wright, a charter member of the WFIWC.

The 7000 black-and-white photographs at PSW, Berkeley, dating to G.E. Burke and J.M. Miller (early 1900s) were characterized by Nancy Rappaport. About 80 percent were taken by Bureau of Entomology personnel prior to 1953 when personnel of the bureau were transferred to the Forest service. The large format negatives are numbered serially and prints, mounted on 5" x 8" cards, are filed behind subject dividers. These photos are the greatest pictorial resource relating to the history of western forest entomology during the first half of the century. Because of Nancy's diligence, she has located a numerical catalog listing the caption of each photo. The history committee will seek a photocopy of the catalog, after which a proposal will be developed by which photos may be retrieved by subjects as well as negative number. A letter of that intent will be sent to the PSW director.

The 2800 pages of correspondence during 1909-1916 between A.D. Hopkins, first chief of Forest Insect Investigations, and his employee, Josef Brunner, in Montana were discussed by Mal Furniss. They are now condensed onto 30 microfiche cards available at the Special Collections Library, University of Idaho. Furniss has written a manuscript based on the

correspondence for submission to "Montana. The Magazine of Western History." It deals particularly with the relationship of Brunner and Hopkins and his running conflict with the Forest Service's attitude regarding fire being more important than insect "depredation." The correspondence also illuminates the changes that have occurred in forest entomology since its beginning in the northern Rocky Mountains when Brunner was hired in 1909, and a wealth of other historical information.

Les Safranyik read recollections by Bob Deboo of his mentor, Hector Richmond (1902-1989), whom he new over a 25-year period. Hec worked for the Canadian government for 30 years, then was an industry consultant for 16 years. He was a founder of WFIWC and he published reminiscences of his life in the book, *Forever Green*. His files and documents were deposited in the special Collections Library at University of British Columbia. The family retains his many diaries.

# WFIWC MAILING LIST

(Conference Attendees in Bold Face)

ABRAMS, MARC D.
PENN ST UNIV. FERGUSON BLDG
SCHOOL OF FOREST RESOURCES
UNIVERSITY PARK PA. 16802

ACCIAVATTI, BOB
USDA FOR SERV-NE AREA S&PF
180 CANFIED SSTREET
MORGANTOWN, WV 26505

ALFARO, RENE I.
CANADIAN FORESTRY SERVICE
506 W. BURNSIDE RD.
VICTORIA, B.C. CANADA V8Z 1M5

**ALEXANDER, NORM**
6623 - 192ND ST
SURREY, BC CANADA
V4N 3 G 6

AMIRAULT, PETER
NORTHERN FORESTRY CENTRE
5320 122ND STREET
EDMONTON, ALBERTA, CANADA
T6H 3S5

**AMMAN, GENE D.**
INTERMOUNTAIN RES. STATION
507 25TH ST.
OGDEN, UT 84401

ANHOLD, JOHN A.
FOREST PEST MANAGEMENT
4746 S 1990 E.
OGDEN, UT. 84403

**ANTROBIUS, WILLIAM L.**
USDA FOREST SERVICE - TCFPM
P.O. BOX 7669
MISSOULA, MT. 589801

AVERILL, BOB
USFS ROCKY MT REGION
P.O. BOX 25127
LAKEWOOD, CO. 80225

**AZTET, TOM**
USDA FOREST SERVICE
SISKYOU NATIONAL FOREST

**BACKMAN, ROBERT W.**
DEPT OF FOREST RESOURCES
UTAH STATE UNIVERSITY
LOGAN, UT 84322-5215

BANFIELD, MICHAEL
CONSEP MEMBRANES, INC.
P.O. BOX 6059
BEND, OR. 97708

BARCLAY, HUGH
PACIFIC FORESTRY CENTRE
506 W BURNSIDE RD.
VICTORIA, B.C., CANADA V8Z 1M5

BARGER, JACK H.
USDA FOREST SERVICE
359 MAIN RD.
DELAWARE, OH 43015

BARR, BARBARA A.
COOP EXTENTION 28 GIANNINI
UNIVERSITY OF CALIFORNIA
BERKELY, CA 94720

BARRAS, STAN
T-10210, US POSTAL SERVICE BLDG.,
701 LOYOLA AVE
NEW ORLEANS, LA 70113

**BARTOS, DALE**
USDA FOREST SERVICE
860 N 1200 E
LOGAN, UT 84321

BEATTY, JEROME S.
USDA FS FPM
P.O. BOX 3623
PORTLAND OR. 97208

BECKMAN, DAVID P.
IDAHO DEPT. OF LANDS
P.O. BOX 670
COUER D'ALENE, ID 83814

BECKWITH, ROY C.
FORESTRY SCIENCES LAB
3200 JEFFERSON WAY
CORVALLIS OR. 97331

BEDARD, BILL
USDA FOREST SERVICE
P.O. BOX 425
BERKELEY CA 94701

**BEGIN, EMILE**
P.O. BOX 2587
INVERMERE, B.C. CANADA
V0A 1A0

**BELL, CAROL**
USFS FPM REGION ONE
FEDERAL BUILDING
P.O. BOX 7669
MISSOULA, MT. 59807

**BENNET, DAYLE D.**
USDA FS FPM SOUTHWEST. REG.
517 GOLD AVE. SW.
ALBUQUERQUE, NM 87102

**BENTZ, BARBARA J.**
FOREST SCIENCES LAB
860 N 1200 E
LOGAN UT. 84321

BERRY, JACK
USDA FOREST SERVICE
2121 C 2ND STREET
DAVIS CA 95616

**BERRYMAN, ALAN A.**
WASH. STATE UNIV.
DEPT. ENTOMOLOGY
PULLMAN, WA. 99164

**BERTRAM, SALLY**

**BILLINGS, RONALD F.**
TEXAS FOREST SERVICE
P.O. BOX 310
LUFKIN, TX 75901

BLAKE, ELIZABETH A.
N. ARIZONA UNIVERSITY
BOX 4098
FLAGSTAFF, AZ 86011

BLITZ, BETH
USDA FOREST SERVICE
201 E 9TH AVE, SUITE 206
ANCHORAGE, AK 99501

BOLLENBACHER, BARRY
USFS FLATHEAD NAT'L FOREST
SWAN LAKE RANGER DISTRIC T
BIG FORK, MT 59911

BONAR ,RON
P.O. BOX 907
BAKER, OR. 97814

BOOSER, JO
USDA FOREST SERVICE
DESHCUTES SO
BEND, OR 97701

**BORDEN, JOHN H.**
SIMON FRASER UNIV.
BURNABY, B.C.
CANADA V5A 1S6

BOUSFIELD, WAYNE
2516 HIGHWOOD DRIVE
MISSOULA, MT 59803

**BOWEN, A. TEMPLE JR.**
NOVO NORDISK BIOINDUSTRIALS
FORESTRY PRODUCTS
33 TURNER ROAD
P.O. BOX 1907
DANBURY, CT. 06813-1907

**BRAUN, DAVID M.**
2321 N 57TH STREET
SEATTLE ,WA 98102

BREWER, WAYNE
MONTANA STATE UNIVERSITY
DEPARTMENT OF ENTOMOLOGY
BOZEMAN, MT 59717

BRIDGES, J. ROBERT
USDA FOREST SERVICE FIDR
RM. 609 RPE P.O. BOX 96090
WASHINGTON, D.C. 20090-6090

**BRIDGEWATER, DAVID R.**
USFS PAC NW REGION
P.O. BOX 3623
PORTLAND, OR 97208

**BROOKS, JULIE**
BOX 452
KALEDEN, BC CANADA
V0H 1K0

**BROSTER, CHRIS**
BCFS
BAG 5000
MACKENZIE, BC CANADA
V0J 2C0

**BURKE, STEVE**
PHERO TECH INC.
7572 PROGRESS WAY
DELTA, BC, CANADA
V4G 1E9

BURNS, DAVID M.
CALIFORNIA DEPT. OF FORESTRY
5100 MT. RAINIER DR.
SACRAMENTO , CA. 95842

# WFIWC MAILING LIST

(Conference Attendees in Bold Face)

**BURNSIDE, ROGER E.**
ALASKA DEPT. OF NAT. RES.
DIVISION OF FORESTRY
ANCHORAGE, AK 99510-7005

BUSH, PARSHALL
UNIVERSITY OF GEORGIA
110 RIVERBEND RES.
ATHENS, GA 30605

BYFORD, GEOFF
DEPT. OF FOR. SCIENCES, U.B.C.
2357 MAIN MALL
VANCOUVER, B.C. V6T 1W5

**BYLER, JAMES**
USDA FOREST SERVICE
PO BOX 7669 FEDERAL BLDG
MISSOULA MONTANA
59807

**BYRNE, PAT**
BCFS
BAG 4400
MERRITT, BC, CANADA
V0K 2B0

CADE, STEVE
WEYERHAEUSER COMPANY
P.O. BOX 1060
HOT SPRINGS. AR 71902

**CAIN, ROBERT**
NMSU EXTENSION, NMNRD,
FORESTRY DIV. PO BOX 1948
SANTA FE, NM 87504

**CAMACHO, ALEX**
SIMON FRASER UNIV.
DEPT. OF BIOLOGICAL SCIENCES
BURNABY, B.C.
CANADA V5A 1S6

CAMERON, E. ALAN
106 PATTERSON BLDG.
PENN STATE UNIVERSITY
UNIVERSITY PARK, PA 16902

CAMERON, SCOTT R.
USFS TEXAS FOREST SERVICE
P.O. BOX 310
LUFKIN, TX 75091

CAMPBELL, NANCY
USFS-FPM REGION ONE
USDA FOREST SERVICE
FEDERAL BLDG., PO BOX 7669
MISSOULA, MT. 59807

CARLIN, ROB
USFS KOOTENAI NF
P.O. BOX 116 MURPHY LAKE RS
FORTINE, MT 59918

CARLSON, CLINT
USDA FOREST SERVICE FSL
P.O. BOX 8089
MISSOULA MT 59833

**CARLSON, JERRY**
PHERO TECH INC.
7572 PROGRESS WAY R.R. #5
DELTA, B.C. CANADA V4G 1E9

**CARTER, JANE**

CATES, REX G.
BYU BOTANY AND RANGE SCIENCE
499 WIDB
PROVO, UT 84602

CELAYA, BOB
ARIZONA STATE LAND DEPT
1625 W. ADAMS
PHOENIX, AZ 85007

CEREZKE, HERB
NORTHERN FORESTRY CENTRE
5320 122ND STREET
EDMONTON ALBERTA, CANADA
T6H 3S5

CHANDLER, CHERRY A.
ARIZONA COMM. OF AG. & HORT.
1688 W. ADAMS
PHOENIX, AZ 85007

CHANG, MING TU
U.S. FOREST SERVICE
359 MAIN RD.
DELAWARE, OH 43015

CHAVEZ, MIKE
USFS SOUTHWESTERN REGION
517 GOLD AVENUE S.W.
ALBUQUERQUE, NM 87102

**CHONG, LESLIE**
SIMON FRASER UNIVERSITY
DEPT. OF BIOLOGICAL SCIENCES
BURNABY, BC CANADA V5A 1S6

CHURCHER, JOE
FOR. HEALTH & PROT., OMNR
P.O. BOX 1000
SAULT STE. MARIE, ONTARIO
P6A 5N5

CIESLA, WILLIAM M.
USDA FS FPM
P.O. BOX 3623
PORTLAND, OR. 97208-3623

CLANCY, KAREN M.
FORESTRY SCIENCES LAB
700 S. KNOLES DR
FLAGSTAFF, AZ 86001

COLBERT, JIM
USDA FOREST SERVICE
P.O. BOX 4360
MORGANTOWN, WV 26505

COLLARD, ERNEST B.
WALLOWA-WHITMAN NF
P.O. BOX 907
BAKER OR 97814

COOK, STEPHEN P.
DEPT. OF ENTOMOLOGY, BOX 7627
NC STATE UNVERSITY
RALEIGH, NC 27695-7626

CORNEIL, JEFFREY A.
OREGON STATE DEPT. OF FOR.
ROUTE 2. BOX 357
PRINEVILLE, OR 97754

COSTER, JACK E.
WEST VIRGINIA UNIVERSITY
P.O. BOX 2941
MORGANTOWN WV 26506-6125

COTA, JESUS
USFS SOUTHWESTERN REGION
517 GOLD AVENUE SW
ALBUQUERQUE, NM 87102

**COULSON, ROBERT N.**
DEPT. OF ENTOMOLOGY
TEXAS A&M UNIVERSITY
COLLEGE STATION, TX 77843

COZENS, RUSS
B.C. FOREST SERVICE
TIMBER HARVESTING BRANCH
1450 GOVERNMENT ST.
VICTORIA, B.C. CANADA V8W 3E7

CROOKSTON, NICHOLAS L.
INTER. FOREST & RANGE EXP. ST
1221 S MAIN STREET
MOSCOW, ID 83843

CROZIER, TOM,
C/O CORRECTION SERVICES
P.O. BOX 50
HARRISON MILLS, BC CANADA

CURTIS, O'NEIL
12635 GROVE ST.
BROOMFIELD, CO 06804

DAHLSTEN, DON
UNIVERSITY OF CALIFORNIA
DIVISION OF BIOLOGICAL CONTROL
BERKELEY, CA 94720

**DALE, JOHN W.**
USDA FOREST SERVICE, FPM
630 SANSOME ST
SAN FRANCISCO, CA 94111

DATERMAN, GARY
PNW FOREST & RANGE EXP. STN.
3200 JEFFERSON WAY
CORVALLIS. OR 97331

DAVID, LANCE ROSS
USDA FOREST SERVICE
3825 E MULBERRY
FORT COLLINS, CO 80524

DEMARS, CLARENCE J.
FOREST AIRPHOTO ANALYSTS
948 ARLINGTON BLVD
EL CERRITO, CA 94530

DENTON, BOB
1106 N 12TH STREET
COEUR D'ALENE, ID 83814

DENTON, WILLIAM H.
AGRI-SENSE
4230 W SIFT AVE., SUITE 106
FRESNO, CA 93722

**DEVELIN, DARRELL**
SIMON FRASER UNIV.
DEPT. OF BIOLOGICAL SCIENCES
BURNABY, B.C.
CANADA V5A 1S6

**DEWEY, JED**
USDA FOREST SERVICE
PO BOX 7669
MISSOULA, MT 59806

# WFIWC MAILING LIST

(Conference Attendees in Bold Face)

DIRECTOR, FPM
USDA FS FPM RM 204
PO BOX 96090
WASHINGTON, DC 20013-6090

DIX, MARY ELLEN
ROCKY MTN FOR & RANGE EXP. ST
EAST CAMPUS-UNIV. OF NEBRASKA
LINCOLN, NE 68583-0822

DIXON, E.A.
DEPT OF CHEM-UNIV OF CALGARY
2500 UNIVERSITY DRIVE NW
CALGARY, ALTA ., CANADA T2N 1N4

DOANE, CHARLES C.
SCENTRY, INC
PO BOX 426
BUCKEYE, AZ 85326

**DOERKSEN, BRUCE**
BCFS
2000 S. OSPIKA BLVD
PRINCE GEORGE, BC
CANADA V2N 4W5

DOMIS, GARY
PO BOX 116
FREDONIA, AZ 86022

DORSET, RICHARD
S DAKOTA DIV OF FORESTRY
1429 E SIOUX
PIERRE, SD 57501

**DRAPER, DEAN**
BCFS
1902 THEATRE ST.
CRANBROOK, BC
CANADA V1C 4H4

DRESTADT, STEVE
IPM ED & PUBS
UC DAVIS
DAVIS, CA 95616

DRESSER, RICHARD E.
953 HILLTOP DRIVE
FORTUNA, CA 95540

DUDLEY, STEVE
MORMON LAKE RANGER DIST
4825 S LAKE MARY ROAD
FLAGSTAFF, AZ 86001

DULL, CHARLES W.
USFS SOUTHERN REGION
1720 PEACHTREE RD NW
ATLANTA, GA 30367

DUNBAR, CLARENCE
N ARIZONA UNIVERSITY
BOX 4098
FLAGSTAFF. AZ 86011

DUNN, JAMES P.
USDA FOREST SERVICE
2500 SHREVEPORT WAY
PINEVILLE, LA 71360

EAV, BOV B.
USDA FOREST SERVICE
3825 E MULBERRY
FORT COLLINS, CO 80524

**EBATA, TIM**
PRINCE RUPERT FOREST REGION
BAG 5000
SMITHERS, BC, CANADA V0J 2N0

EDER, ROBERT
USDA FOREST SERVICE TCFPM
PO BOX 7669
MISSOULA, MT 59807

**EGLITIS, ANDRIS**
USDA FS DESCHUTES NF
1645 HIGHWAY 20 EAST
BEND, OR 97701

**ELLIOT, ROSS**
BCFS, BOUNDARY F.D.
GRAND FORKS, BC
CANADA V0H 1H0

FAIRWEATHER, MARY LOU
USDA FOREST SERVICE
2323 GREENLAW LANE
FLAGSTAFF, AZ 86004

FELLON, DAVE
2615 SYCAMORE AVE
MISSOULA, MT 59801

FENN, MARK
FOREST FIRE LAB
4955 CANYON CREST DR
RIVERSIDE CA 92507

FERRELL, GEORGE T.
USDA FOREST SERVICE
2400 WASHINGTON AVENUE
REDDING, CA 96001

FILIP, GREG
FORESTRY AND RANGE SCI. LAB
1401 GEKELER AVE.
LA GRANDE, OR 97850

FLETCHER, STEVEN L.
WALLOWA-WHITMAN NF
1550 DEWEY AVENUE PO BOX 907
BAKER CITY, OR 97814

FOLTZ, JOHN L.
ENTOMOL. & NEMATOLOGY DEPT.
BLDG. 970, HULL ROAD
UNIVERSITY OF FLORIDA
GAINESVILLE, FL 32611-0740

FOREY, DAN
AGRI-SENSE
4230 W SWIFT AVENUE, SUITE 106
FRESNO, CA 93722

FOX, JOSEPH
UC BERKELEY
2100 WELLMAN HALL - ENT
BERKELEY, CA 94720

FRANTZ, DAVE
ARIZONA STATE LAND DEPT.
3650 LAKE MARY RD.
FLAGSTAFF, AZ 86001

FRASER, DAVID
N ARIZONA UNIV - SCHOOL OF FOR.
BOX 4098
FLAGSTAFF, AZ 86011

**FRASER, GERRY**
CANADIAN PAC. FOR PROD. LTD
PO BOX 459
QUALICUM BEACH, BC CANADA
V0R 2T1

**FURNISS, MAL**
1515 ORCHARD
MOSCOW, ID 83843

GARA, ROBERT I.
COLLECE OF FOR RES. AR 10
UNIVERSITY OF WASHINGTON
SEATTLE, WA 98195

GARDNER, BRIAN W.
USDA FS PEST MNGMT.
1750 FRONT ST. RM 202
BOISE, ID 83702

**GAST, SANDY**
USDA FOREST SERVICE
PEST MANAGEMENT
1201 IRONWOOD DRIVE
COEUR D'ALENE ,ID 83814

**GAY, ROB**
BCFS
1902 THEATRE ST
CRANBROOK, BC
CANADA V1C 4H4

GEILS, BRIAN W.
ROCKY MT. FOR & RANGE EXP. ST
240 W PROSPECT STREET
FORT COLLINS, CO 80526-2098

GIBBS, LORNA
PHERO TECH
7572 PROGRESS WAY
DELTA. BC CANADA V4G 1E9

**GIBSON, KEN**
USDA FS TCFPM
PO BOX 7669
MISSOULA, MT 59807

GILLESPIE, ANDREW J.R.
USDA FOREST SERVICE
3825 E. MULBERRRY
FORT COLLINS, CO 80524

GIRARD, JEROME
PHERO TECH
7572 PROGRESS WAY
DELTA, BC CANADA V4G 1E9

**GOYER, RICHARD A.**
LOUISIANA STATE UNIV
DEPT OF ENTOMOLOGY
BATON ROUGE, LA 70803

GRACE, J. KENNETH
FAC OF FORESTRY
U OF TORONTO
TORONTO, ONT, CANADA M5S 1A1

**GRAY, DAVE**
DEPT. OF ENTOMOLOGY
VIRGINIA POLYTECHNIQUE INST.
BLACKSBURG VA
24026

# WFIWC MAILING LIST

(Conference Attendees in Bold Face)

GRAY, TOM
PACIFIC FORESTRY CENTRE
506 W. BURNSIDE RD.
VICTORIA, BC CANADA V8Z 1M5

GREENE, LULA E.
PAC. SW FOR & RANGE EXP STN
1960 ADDISON ST.
BERKELY, CA 94701

GREGG, TOMMY F.
USFS PAC NW REGION
PO BOX 3623
PORTLAND, OR 97208

**GRIES, GERHARD**
SIMON FRASER UNIVERSITY
DEPT. OF BIOLOGICAL SCIENCES
BURNABY, BC CANADA V5A 1S6

**GRIES, REGINE**
SIMON FRASER UNIVERSITY
DEPT. OF BIOLOGICAL SCIENCES
BURNABY, BC CANADA V5A 1S6

GRIMBLE, DAVID G.
FSL
3200 JEFFERSON WAY
CORVALLIS, OR 97331

HAACK, BOB
USDA FOREST SERVICE
1407 S. HARRISON RD RM 220
E. LANSING, MI 48823

HADFIELD, JIM
USFS
PO BOX 3623
PORTLAND OR 97208

HAIDER, SYED TANVEER
UNIV. OF WASHINGTON
DEPT OF BIOCHEM. SJ-70
SEATTLE WA 98195

**HAIN, FRED P.**
NC STATE UNIV - DEPT OF ENT.
BOX 7627 GRINNELLS LAB
RALEIGH, NC 27695

**HALL, PETER**
BC FOREST SERVICE
2ND FLOOR- BASTION SQUARE
VICTORIA, BC CANADA V8W 3E7

HALL, RALPH C.
72 DAVIS RD.
ORINDA CA 94563

HAMEL, DENNIS
USFS WASHINGTON OFFICE
PO BOX 96090
WASHINGTON, DC 20013-6090

**HAMM, MARK**
BC FOREST SERVICE
540 BORLAND ST.
WILLIAMS LAKE, BC CANADA
V2G 1R8

HANEMAN, DEIDRE
USDA FOREST SERVICE
11177 W 8TH AVE
LAKEWOOD, CO 80225

HANSEN, DAWN
FOREST PEST MANAGEMENT
4746 S 1900 E
OGDEN, UT 84403

**HANLON, C.**

HANSON, JIM
USDA FOREST SERVICE
1922 FIKWEKK AVE
ST PAUL, MN 55108

HARD, JOHN S.
PNW FOR & RANGE EXP STATION
201 E. 9TH AVE
ANCHORAGE, AK 99501

HARRELL, MARK O.
U OF NEBRASKA, DEPT OF FOR.
101 PLANT INDUSTRY
LINCOLN, NE 68583-0814

HARRIS, JERI LYN
DEPT FOR RESOURCES
UTAH STATE UNIV
LOGAN, UT 84322

**HARRIS, JOHN W.E.**
PACIFIC FORESTRY CENTRE
506 W BURNSIDE RD
VICTORIA, BC CANADA V8Z 1M5

HART, DENNIS
USDA FS FPM
630 SANSOME ST ROOM 1037
SAN FRANCISCO, CA 94111

HARVEY, GEORGE T.
FORESTRY CANADA
SAULT STE MARIE, ONT, CANADA
P6A 5M7

**HASTINGS, FELTON L.**
FORESTRY SCIENCES LAB
PO BOX 12254
RESEARCH TRI PARK, NC 27709

**HAUPT, ERIC**
BCFS
2501 14TH AVE
VERNON, BC
CANADA V1T 8Z1

HAVERTY, MICHAEL I.
PSW FOREST & RANGE EXP STN
PO BOX 245
BERKELEY , CA 94701

HEASLEY, JOHN E.
RESOURCE ANALYSIS SYSTEMS
333 WEST DRAKE ROAD, SUITE 240
FORT COLLINS, CO 80526

HEATH, DICK
MINISTRY OF ENVIRONMENT
PESTICIDE MANAGEMENT BRANCH
2569 KENWORTH
NANAIMO, BC CANADA V9T 3H9

HEDDEN, ROY L.
DEPARTMENT OF FORESTRY
CLEMSON UNIVERSITY
CLEMSON, SC 29631

HEIDMANN, LEROY J.
29 WEST SILVER SPRUCE
FLAGSTAFF, AZ 86001

**HENIGMAN, JOHN**
BCFS
3RD FLOOR, 31 BASTION SQUARE
VICTORIA, BC
CANADA V8W 3E7

**HEPPNER, DON**
BCFS
4595 CANADA WAY
BURNABY, BC
CANADA V5G 4L9

HERMS, DAN
DEPT ENTOMOLOGY
MICHIGAN STATE UNIVERSITY
E. LANSING, MICH. 48640

HIREMATH, SHIVANAND
USDA FOREST SERVICE
359 MAIN ROAD
DELEWARE, OH 43015

HITT, SAM
ECOLOGICAL PEST MANAGEMENT
80 E SAN FRANCISC0
SANTA FE, NM 87501

HOBSON, KEN
DEPTARTMENT OF ENTOMOLOGY
UC BERKELEY
BERKELEY, CA 94720

**HODGKINSON, ROBERT**
BC MINISTRY OF FORESTS
1011 4TH AVENUE
PRINCE GEORGE, BC CANADA
V2L 3H9

HOFACKER, THOMAS H.
USFS WASHINGTON OFFICE
PO BOX 96090
WASHINGTON, DC 20013-6090

HOLLAND, DAVID G.
USDA FS INTERMOUNTAIN REGION
324 25TH STREET
OGDEN, UT 84401

**HOLLINGER, MARGOT**
BCFS
102 INDUSTRIAL PLACE
PENTICTON, BC
CANADA V2A 7C8

HOLMES, MATT
BEND RESEARCH, INC
64550 RESEARCH RD
BEND, OR 97701

HOLMES, KEITH
ROHNE-POULENC
2491 W SHORE DRIVE STE. 123
FRESNO, CA 93711

**HOLSTEIN, ED**
USDA FS FPM
201 EAST 9TH SUITE 201
ANCHORAGE, AK 99501

**HOLT, JOAN**
BOX 922
KAMLOOPS, BC
CANADA V2C 5N4

# WFIWC MAILING LIST

(Conference Attendees in Bold Face)

HOMAN, HUGH W.
U OF IDAHO
DEPT OF ENTOMOLOGY
MOSCOW, ID 83843

HONEA, RONALD C.
MISS. ST UNIV - DEPT OF ENT
PO BOX DRAWER EM
MISSISSIPPI STATE , MS 39762

**HOSTETLER, BRUCE B**
USDA FOREST SERVICE FPM
PO BOX 3623
PORTLAND, OR 97208

HOWARD, BENTON
4129 SE STARK
PORTLAND, OR 97214

HRYNYSHYN, DONNA F.
U OF WY - PLANT SCIENCE DEPT
BOX 3354
LARAMIE, WY 82071

**HUDSON, DON A.**
BCFS
BAG 100
SALMON ARM BC
CANADA V1E 4S4

HUGHES, JOHN M.
USFS NORTHERN REGION
PO BOX 7669
MISSOULA, MT 59807

**HULME, MIKE**
FORESTRY CANADA
506 WEST BURNSIDE RD
VICTORIA, BC, CANADA V8Z 1M5

**HUMBLE, L.M.**
FORESTRY CANADA
506 WEST BURNSIDE RD
VICTORIA, BC, CANADA V8Z 1M5

HUNT, RICHARD
CALIFORNIA DEPT OF FORESTRY
1416 9TH STREET
SACRAMENTO, CA 95814

IDAHO DEPARTMENT OF LANDS
c/o LARRY FRYBERG
PO BOX 909
SANDPOINT, ID 83864

**IRVING, H.J.**

IRWIN, EUGENE A.
OREGON ST DEPT OF FORESTRY
2600 STATE STREET
SALEM, OR 97310

JENKINS, MICHAEL J.
UTAH STATE UNIVERSITY
DEPARTMENT OF FOREST
RESOURCES
LOGAN, UT 84322-5215

JENNINGS, DAN
USDA FOREST SERVICE FLS
PO BOX 4360
MORGANTOWN, WV 26505

JENSON, GARY
PACIFIC FORESTRY CENTRE
506 WEST BURNSIDE ROAD
VICTORIA, BC CANADA V8Z 1M5

**JOHNSEY, RICK L.**
WASHINGTON ST DEP OF NAT. RES.
MAIL STOP MQ - 11
OLYMPIA, WA 98504

**JOHNSON, BOB**
BCFS
BAG 100
SALMON ARM, BC
CANADA V1E 4S4

JOSEPH, GLADWIN
OREGON ST UNIVERSITY
DEPARTMENT OF ENTOMOLOGY
CORVALLIS, OR 97331

KALE, P.B.
UNIVERSITY OF IDAHO
DEPT OF FOREST RESOURCES
MOSCOW, ID 83843

KALVE, VALERIE
USDA FS FPM
507 25TH ST
OGDEN, UT 84401

KEARSLEY, MIKE
N AZ UNIV-DEPT BIO SCI
BOX 5640
FLAGSTAFF, AZ 86011

KEMP, WILLIAM P.
MSU-USDA-ARS
RANGELAND INSECT LAB
BOZEMAN, MT 59717

KINN, DONALD N.
USDA FOREST SERVICE
2500 SHREVEPORT HWY.
PINEVILLE, LA 71360

KINZER, H.G.
NM STATE UNIVERSITY
BOTANY AND ENTOMOLOGY DEPT
LAS CRUCES, NM 88003

**KISS, GYULA**
BCFS 3401 RESEVOIR RD
VERNON BC
CANADA V1B 2C7

**KLINE, LEROY N.**
OREGON ST DEPT OF FORESTRY
2600 STATE ST
SALEM, OR 97310

KNAPP, ANDY
USDA FOREST SERVICE
1750 FRONT ST
BOISE, ID 83702

KNAUER, KEN
USDA FOREST SERVICE
PO BOX 96090
WASHINGTON, D.C. 20013-6090

KNOWLES, KEITH
MANITOBA NATURAL RESOURCES
300-530 KENASTON BLVD
WINNIPEG, MANITOBA CANADA

**KOBYLNYK, RON**
4TH FLOOR, 737 COURTNEY ST
VICTORIA, BC
CANADA
V8V 1X4

KOERBER, THOMAS
ENTOMOLOGICAL SERVICE COMP.
PO BOX 992
BERKELEY, CA 94701

KOHLER, STEVE
MONTANA DIV. OF FORESTRY
2705 SPURGIN ROAD
MISSOULA, MT 59801

KORELIUS, VLAD J.
CIP, IN., TAHSIS PAC REGION
8067 E SAANICH RD, RR #1
SAANICHTON, BC CANADA V0S 1M0

KORN, MICHAEL J.
USDA FOREST SERVICE
PO BOX 38
UNITY, OR 97884

**KORO, BRENDA**
BCFS CHILLIWACK FD
BOX 159
ROSEDALE, BC
CANADA V0X 1X0

**KOWLER, S.**

**KRANNITZ, SHAN**
PHERO TECH INC
7572 PROGRESS WAY
DELTA, BC CANADA V4G 1E9

KRASKE, JOHN
AZ STATE LAND DEPT
3650 LAKE MARY RD
FLAGSTAFF, AZ 86001

KREBILL, DICK
USDA FOREST SERVICE, INT
324 25TH STREET
OGDEN, UT 84403

KULMAN, HERBERT M.
UNIV. OF MINNESOTA
DEPT OF ENTOMOLOGY
SAINT PAUL, MN 55108

KUMI, JANNA
MACMILLAN BLOEDEL LTD.
65 FRONT STREET,
NANAIMO, BC CANADA V9R 5H9

KUNIS, DAN
8060 NIWOT RD
#30
LONGMONT, CO 80501

**LACEY, TOM**
BCFS
BAG 4400
MERRITT, BC
CANADA V0K 2B0

LAMADELEINE, LEON
USDA FS FPM
507 25TH ST
OGDEN, UT 84401

LANGOR, DAVE
NORTHERN FORESTRY CENTRE
5320 122ND ST
EDMONTON, ALTA. CANADA
T6G 3S5

# WFIWC MAILING LIST

(Conference Attendees in Bold Face)

LAUT, JOHN
COLORADO STATE FOREST SERVICE
PO BOX 2189
DILLON, CO 80435

LAVIGNE, ROBERT
DEPT OF PLANT, SOIL, ENT
BOX 3354 UNIV OF WYOMING
LARAMIE, WY 82071

LEATHERMAN, DAVID A.
COLORADO STATE FOREST SERVICE
COLORADO ST UNIV
FORT COLLINS, CO 80523

**LENHARD, GERALD**

**LEWIS, KORNELIA**
FOREST SCIENCES , UBC
2357 MAIN MALL
VANCOUVER BC CANADA V6T 1Z4

LESSARD, GENE
USDA FS FPM ALASKA REGION
201 E 9TH AVE
ANCHORAGE AK 99501

LEWIS, VERNARD
DEPT ENTOMOLOGY
UC BERKELELY
BERKELEY, CA 94720

LIEBHOLD, SANDY
USDA FOREST SERVICE
PO BOX 4360
MORGANTOWN, WV 26505

**LIEBL, JOSEPH R.**
USDA FOREST SERVICE
PO BOX 579
WINTHROP, WA 98862

LIH, MARITA P.
UNIV OF ARKANSAS, DEPT OF ENT
AGRICULTURE BLDG ROOM 320
FAYETTEVILLE, AR 72701

LIN, YIQUN
N AZ UNIV SCHOOL OF FORESTRY
BOX 4098
FLAGSTAFF, AZ 86011

LINDGREN, STAFFAN
PHERO TECH INC
7572 PROGRESS WAY RR#5
DELTA, BC CANADA V4G 1E9

**LINIT, MARC**
ENTOMOLOGY DEPARTMENT
UNIVERSITY OF MISSOURI
COLOMBIA. MO 65211

LINN, JOE
DORENA TREE IMPROVE. CENTRE
PO BOX 7
COTTAGE GROVE. OR 97424

LINNANE, JIM
517 GOLD AVE SW
ALBUQUERQUE, NM 87102

LISTER, KEN
USFS ROCKY MT REGION
PO BOX 25127
LAKEWOOD, CO 80225

**LIVINGSTON, R. LADD**
IDAHO DEPT OF LANDS
PO BOX 670
COEUR D'ALENE ID 83814

**LOGAN, JESSE A.**
VIRGINIA POLYTECH & STATE UNIV
DPEARTMENT OF FORESTRY
BLACKSBURG, VA 24061-0324

LOGAN, ROBERT
SCHOOL OF FORESTRY
UNIVERSITY OF MONTANA
MISSOULA, MT 59812

LONG, DAVID
N ARIZONA UNIV
BOX 4098
FLAGSTAFF, AZ 86011

LONG, GARRELL E.
WASHINGTON STATE UNIV
DEPARTMENT OF ENTOMOLOGY
PULLMAN, WA 99164-6432

LOOD, RUDIE
PO BOX 343
HAYDEN LAKE, ID 83835

**LORIO, PETER L. JR.**
USDA FS SFES
2500 SHREVEPORT HWY
PO BX 5500
PINEVILLE. LA 71360

LOVE, BILL
IDAHO DEPT OF LAND
PO BOX 670
COUER D'ALENE, ID 38814

LOVELADY, N CLARK
DEPARTMENT OF ENTOMOLOGY
TEXAS A&M UNIVERSITY
COLLEGE STATION, TX 77843

LUCK, ROBERT F.
UNIV OF CA DIV OF BIO CONTROL
DEPARTMENT OF ENTOMOLOGY
RIVERSIDE CA 92521

LYNCH, ANN N
ROCKY MTN FOR & RANGE EXP STN
240 W PROSPECT ST
FORT COLLINS, CO 80526-2098

LYON, ROBERT L.
USFS WASHINGTON OFFICE
PO BOX 90960
WASHINGTON, D.C. 20013-6090

**MACIAS, JORGE**
SIMON FRASER UNIVERSITY
DEPT. OF BIOLOGICAL SCIENCES
BURNABY, BC CANADA V5A 1S6

**MACLAUCHLAN, LORRAINE**
*c/o* MINISTRY OF FORESTS
515 COLUMBIA ST.
KAMLOOPS, BC CANADA V2C 5K9

MANGOLD, ROB
USFS
COTTAGE GROVE RD
COTTAGE GROVE, OR 97424

MANTHEI, MICHAEL D.
COCONINO NF
2323 E GREENLAW LANE
FLAGSTAFF, AZ 86001

MARKIN, GEORGE P.
PSW FOR & RANGE EXP STATION
1151 PUNCHBOWL ST, ROOM 323
HONOLULU, HI 96813

**MARSDEN, MICHAEL A.**
USDA FS ROCKY MTN STATION
240 W PROSPECT
FORTCOLLINS, CO 80526-2098

MASON, GARLAND N.
USDA FS PSW
PO BOX 245
BERKELEY, CA 94701

MASON, RICHARD R.
USDA FS PNW
1401 GEKELER LANE
LAGRAND, OR 97850

MATA, S.A.
RM STN
240 W. PROSPECT
FT COLLINS, CO 80526

MATTSON, CARL J.
KETTLE FALLS RD
COLVILLE NF
KETTLE FALLS WA 99141

MAULDIN, JOE
SOUTHERN FOREST EXP STN
PO BOX 2008
GULFPORT, MS 39505

MAY, TAMMY
USDA FOREST SERVICE FSL
3200 JEFFERSON WAY
CORVALLIS, OR 97331

**MC COMB, DAVID (RED)**
PO BOX 163
WINTHROP, WA 98862

MC CONNEL, TIM
USDA FS PO BOX 3623
319 SW PINE
PORTLAND OR 97208

MC CULLOUGH, DEBBIE
UNIV OF MINN. DEPT OF ENT
HODSON HALL
ST PAUL, MN 59801

MC GREGOR, MARK
1916 - 35TH ST
MISSOULA, MT 59801

**MCINTOSH, RORY**

MC KNIGHT, MEL
426 PEEKSKILL LANE
FAIRFAX, VA 22033

MC WILLIAMS, MIKE
FOREST SCIENCES LABORATORY
3200 JEFFERSON WAY
CORVALLIS, OR 97331

# WFIWC MAILING LIST

(Conference Attendees in Bold Face)

**MCLEAN, JOHN A.**
FOREST SCIENCES , UBC
2357 MAIN MALL
VANCOUVER BC CANADA V6T 1Z4

**MASK, ROY**
USDA FOREST SERVICE
STATE AND PRIVATE FORESTRY
2770 SHERWOOD LANE, SUITE 2A
JUNEAU, AK 99801

MENEELY, SCOTT C
US BUREAU OF INDIAN AFFAIRS
BRANCH OF FORESTRY, BOX 209
SAN CARLOS, AZ 85550

MERICKEL, FRANK W.
PLANT, SOIL AND ENT. SCIENCES
UNIVERSITY OF IDAHO
MOSCOW, IDAHO 83843

MERRIL, LAURA D.
USDA FS STATE & PRIV. FORESTRY
630 SANSOME ST
SAN FRANCISCO , CA 94111

MEXAL, JOHN
NEW MEXICO STATE UNIVERSITY
DEPT OF AGRONOMY & HORT.
LAS CRUCES, NM 88003

MEYER, HUBERT
2532 HIGHWOOD DR
MISSOULA, MT 59803

**MILLER, DAN**
PHERO TECH INC.
7572 PROGRESS WAYM RR#5
DELTA, BC CANADA V4G 1E9

**MILLER, GORDON**
PACIFIC FORESTRY CENTRE
506 W BURNSIDE RD
VICTORIA, BC CANADA V8Z 1M5

MILLER, JEFFREY C.
DEPT OF ENTOMOLOGY
OREGON STATE UNIVERSITY
CORVALLIS, OR 97331

MILLER, MITCHELL C.
SOUTHERN FOREST EXP. STN
2500 SHREVEPORT HWY
PINEVILLE, LA 71360

MITCHELL, JAMES C.
BOX 900
RT. #4
FLAGSTAFF, AZ 86001

MITCHELL, RUSS
USDA FS SILVICULTURE LAB
1027 NW TRENTON AV
BEND, OR 97701

MITTON, JEFF
UNIV OF COLORADO
DEPT OF EPO BIOLOGY
BOULDER, CO 80309

MOCETTINI, PHIL
USDA FOREST SERVICE
1750 FRONT ST RM 202
BOISE, ID 83702

MOECK, HENRY
PACIFIC FORESTRY CENTRE
506 W BURNSIDE RD
VICTORIA, BC, CANADA V8Z 1M5

MOODY, BEN
CANADIAN FORESTRY SERVICE
351 ST JOSEPH BLVD
HULL, QUEBEC, CANADA K1A 1G5

MOORE, MARGARET M.
N AZ .UNIV - SCHOOL OF FORESTRY
BOX 4098
FLAGSTAFF, AZ 86011

MORSE, BRUCE W.
UNIV OF MN - DEPT OF ENT
HODSEN HALL
ST PAUL, MN 55108

MOSER, JOHN C.
S FOREST EXPERIMENT STATION
2500 SHREVEPORT HWY
PINEVILLE, LA 71360

**MOTTISHAW, JIM**
BCFS
102 INDUSTRIAL PLACE
PENTICTON, BC
CANADA V6T 1Z4

MUDGE, ALAN
OREGON DEPT OF AGRICULTURE
635 CAPITOL STREET NE
SALEM, OR 97310-0110

**MUNSON, STEVE**
USDA FS FPM
324 25TH ST
OGDEN, UT 84401

MYHRE, RICHARD J
USFS FPM/MAG
3825 E MULBERRY
FT COLLINS, CO 80524

MYLES, TIMOTH G.
FACULTY OF FORESTRY
33 WILLCOCKS ST.
UNIVERSITY OF TORONTO
TORONTO ONTARIO, CANADA
M5S 3B3

NASH, BRUCE
PENN ST UNIV
DEPT OF PLANT PATHOLOGY
UNIVERSITY PARK, PA 16802

NE, ZHONG
OREGON ST UNIVERSITY
ENTOMOLOGY DEPT
CORVALLIS, OR 97331

**NEBEKER, T. EVAN**
MSU DEPT OF ENTOMOLOGY
PO DRAWER EM
MISSISSIPPI STATE, MS 39762

NEFF, DAVID
CDF & FD
2524 MULBERRY ST
RIVERSIDE, CA 29502

NEISESS, JOHN
USFS PAC SW REGION
630 SANSOME ST
SAN FRANCISCO, CA 94111

NELSON, BRYAN
STATE FORESTRY
2600 STATE ST
SALEM, OR 97310

**NICHOLSON, STEPHEN**

NIELSON, DAVID G.
DEPT OF ENTOMOLOGY
OSU-OARDC
WOOSTER, OH 44691

**NIWA, CHRISTINE G.**
PNW FOREST & RANGE EXP. STN.
3200 JEFFERSON WAY
CORVALLIS, OR 97331

OHMART, CLIFFORD P.
CSIRO, DIV OF FOR RES
BOX 4008, QUEEN VICTORIA TERR.
CANBERRA, A.C.T. 2600 AUSTRALIA

**OLSEN, BRENT**
BCFS
1255 DALHOUSIE DRIVE
KAMLOOPS, BC
CANADA V2C 5Z5

ONKEN, BRAD
USDA FOREST SERVICE
180 CANFIELD ST
MORGANTOWN, WV 26505

ONO, HIDEJI
ALBERTA FORESTRY
PO BAX 7040, POSTAL STN M
EDMONTON, ALBERTA, CANADA
T5E 5S9

OSTROWSKI, RICHARD C.
UNITED AG PRODUCTS
PO BOX 1286
GREELEY, CO 80632

**OTVOS, IMRE S.**
PACIFIC FORESTRY CENTRE
506 W BURNSIDE RD
VICTORIA, BC CANADA V8Z 1M5

OVERHULSER, DAVID L.
OR STATE DEPT OF FORESTRY
2600 STATE ST
SALEM ,OR 97310

**OWEN, DONALD R.**
CA DEPT OF FORESTRY
6105 AIRPORT RD
REDDING, CA 96002

PAGE, MARION
PSW FOR & RANGE EXP STN
1960 ADDISON ST
BERKELEY , CA 94701

**PAINE, TIMOTHY D.**
UNIV OF CALIFORNIA
DEPT OF ENTOMOLOGY
RIVERSIDE, CA 92521

PANDILA, MADAN
SASKATCHEWAN PKS. RES. & CUL.
PO BOX 3003
PRINCE ALBERT, SASK, CANADA

# WFIWC MAILING LIST

(Conference Attendees in Bold Face)

PARKER, DOUGLAS
USDA FOREST SERVICE
517 GOLD AVENUE SW
ALBUQUERQUE, NM 87102

**PARRY, DYLAN**

PASEK, JUDITH E.
USDA FOREST SERVICE
501 E ST JOE ST., SDSMT
RAPID CITY, SD 57701

**PAYNE, THOMAS L.**
DEPARTMENT OF ENTOMOLOGY
VIRGINIA TECH.
BLACKSBURG, VA 24061

PEAVY, ANDREW T.
PO BOX O
SAN CARLOS, AZ 85550

**PETERSON, GARY J.**
USDA FOREST SERVICE
SISTERS R.D., PO BOX 249
SISTERS, OR 97759

PETTINGER, LEON
16252 BLUFF RD
SANDY, OR 97055

PHILLIPS, GREGORY C.
NM STATE UNIV-
DEPT OF AG. AND HORT.
LAS CRUCES, NM 88003

PHILLIPS, THOMAS W.
DEPT OF ENT-UNIV OF FLORIDA
3103 MCCARTY HALL
GAINESVILLE.FL 32611

**PIGGIN, DAVID**
BCFS
1255 DLAHOUSIE DRIVE
KAMLOOPS, BC
CANADA
V2C 5Z5

**POIRIER, LISA**
SIMON FRASER UNIVERSITY
DEPT. OF BIOLOGICAL SCIENCES
BURNABY, BC CANADA V5A 1S6

**POLAND, THERESA**
SIMON FRASER UNIVERSITY
DEPT. OF BIOLOGICAL SCIENCES
BURNABY, BC CANADA V5A 1S6

PRICE, PETER W.
N ARIZONA UNIV-DEPT OF BIO SCI
BOX 5640
FLAGSTAFF, AZ 86011

PYWELL, H. ROSS
USDA FOREST SERVICE
3825 E MULBERRY
FORT COLLINS, CO 80524

**RAGENOVICH, IRAL**
USFS PAC NW REGION
PO BOX 3623
PORTLAND, OR 97208

**RAIMO, BERNIE**
USDA FOREST SERVICE FPM
216 N COLORADO
GUNNISON, CO 81230

RANDALL,. WILLIAM
USDA FOREST SERVICE
PO BOX 1148
CORVALLIS, OR 97339

RANASINGHE, SUNIL K.
PROVINCIAL FOREST FIRE CENTRE
FOREST PROTECTION BRANCH
ALBERTA FOREST SERVICE
10725 120TH AVENUE
EDMONTON ALTA T5G 0S8

**RANKIN, LEO**
BC FOREST SERVICE
540 BORLAND STREET
WILLIAMS LAKE, BC CANADA
V2G 1R8

**RAPPAPORT, NANCY G.**
PAC SW FOR & RANGE EXP ST.
1960 ADDISON ST
BERKELEY, CA 94704

RASMUSSEN, LYNN A.
INTERMOUNTAIN RES. STN
507 25TH ST.
OGDEN, UT 84401

RATCLIFF, ALICE
752 EVERETT ST
EL CERRITO, CA 94530

RAVLIN, FOREST W.
DEPT OF ENTOMOLOGY
VPI & SU
BLACKSBURG, VA 24061

**REYNOLDS, KEITH M.**
FOREST SCIENCE LABORATORY
PACIFIC NORTHWEST RES. STN.
201 E 9TH AVENUE, SUITE 303
ANCHORAGE, AK 99501

RHODES, DAVID
CFR
UNIV OF WASHINGTO
SEATTLE, WA 98195

RICHMOND, CHUCK
USDA FS PSW
PO BOX 245
BERKELEY, CA 94701

**RIOS, JESSE**

ROBERTS. JOY
1750 FRONT ST
ROOM 202
BOISE, ID 83702

ROBERTSON, ALLEN S.
CAL. DEPT FORESTRY AND FIRE
181 14 BOLLINGER CANYON RD
SAN RAMON, CA 94583

ROBERTSON, JACQUELINE L.
PAC SW FOR & RANGE EXP STN.
1969 ADDISON ST
BERKELEY, CA 94704

ROCKWELL, KEN
USDA FS
3502 HWY 30
LA GRANDE OR 97850

**ROETTGERING, BRUCE H.**
USDA FS FPM
630 SANSOME ST
SAN FRANCISCO , CA 94111

ROGERS, TERRY
USDA FS FPM
517 GOLD SW
ALBUQUERQUE, NM 87102

**ROSS, DARRELL**
COLLEGE OF FORESTRY
OREGON STATE UNIVERSITY
CORVALLIS, OR 97331-5705

ROUSI, MATTI
FINNISH FOR . RES. INSTITUTE
58750 PUNKAHARRVU
HELSINKI, FINLAND

RUTLEDGE, WALLIS
OREGON DEPT FORESTRY
2600 STATE ST
SALEM OR 97310

RYAN, ROGER S.
5427 NW HIGHLAND DRIVE
CORVALLIS, OR. 97330

SAAREMNAA, HANNA T.
FINNISH FOR. RES INST.
UNIONIKATU 40A
00170 HELSINKI FINLAND

SACCHI, CHRISTOPHER F.
N ARIZONA UNIV-DPET OF BIO SCI
BOX 5640
FLAGSTAFF, AZ 86011

**SAFRANYIK, LES**
PACIFIC FORESTRY CENTRE
506 W BURNSIDE RD
VICTORIA, BC CANADA V8Z 1M5

SAHOTA, TARA S.
PACIFIC FORESTRY CENTRE
506 W BURNSIDE RD
VICTORIA, BC CANADA V8Z 1M5

**SALOM, SCOTT M.**
DEPT OF ENTOMOLOGY
VIRGINIA POLYTECHNIQUE
INSTITUTE
BLACKSBURG, VA 24026

SANDERS, CHRIS
FORESTRY CANADA PO BOX 490
SAULT STE MARIE, ONTARIO,
CANADA
P6A 5M7

**SANDQUIST, ROGER**
USDA FOREST SERVICE
PO BOX 3623
PORTLAND , OR 97208

SARTWELL, CHARLES
USDA FOREST SERVICE
3200 SW JEFFERSON
CORVALLIS, OR 97333

**SCHAUB, LUCAS P.**
DEPT. OF ENTOMOLOGY
VPI & SU
BLACKSBURG, VA 24061

# WFIWC MAILING LIST

(Conference Attendees in Bold Face)

SCHENK, JOHN A.
U OF I COLLEGE OF FORESTRY
FOREST RESOURCES
MOSCOW, ID 83843

**SCHMID, JOHN M.**
ROCKY MTN FOR& RANGE EXP ST
240 W PROSPECT STREET
FORT COLLINS, CO 80526-2098

SCHMIDT, ELMER L.
DEPT FOR PROD
2004 FOLWELL AVE
ST PAUL, MN 55108

SCHMIDT, WYMAN
USDA FOREST SERVICE
INT RESEARCH STATION
BOZEMAN, MT 59715

**SCHMITZ, DICK**
USDA FOREST SERVICE INT FSL
507 25TH ST
OGDEN, UT 84401

SCHOMAKER, MIKE
COLORADO STATE FOREST SERV.
COLORADO STATE UNIVERSITY
FORT COLLINS, CO 80523

SCHOWALTER, TIM
OR STATE UNIVERSITY
ENTOMOLOGY DEPT
CORVALLIS OR 97331

**SCHULTZ, DAVE**
USDA FOREST SERVICE
2400 WASHINGTON AVE
REDDING CA, 96001

SCHWALBE, CHARLES P.
USDA-PPQ
GYPSY MOTH LAB
OTIS AFB. MA 02542

SCOTT, DONALD W.
FORESTRY AND RANGE SCI. LAB.
1401 GEKELER LANE
LA GRANDE OR 97850

**SENGER, ED**
PHERO TECH INC.
7572 PROGRESS WAY R.R. #5
DELTA, B.C. CANADA V4G 1E9

**SENGER, SUSAN**
FOREST SCIENCES , UBC
2357 MAIN MALL
VANCOUVER BC CANADA V6T 1Z4

SEYBOLD, STEPHEN J.
UC-BERKELEY
218 WELLMAN HALL
BERKELEY, CA 94720

SHAW, DAVID
COLLEGE OF FOR. RESOURCES
UNIV OF WASHINGTON
SEATTLE, WA 98195

SHAW, JUDITH C.
SCENTRY INC
PO BOX 426
BUCKEYE, AZ 85326

SHAW, TERRI
400 RIDGEWOOD CT.
FT. COLLINS, CO 80524

SHEA, PATRICK J.
PAC SW FOR & RANGE EXP ST
PO BOX 245
BERKELEY, CA 94701

SHEEHAN, KATHARINE A.
USDA FS FPM
PO BOX 3623
PORTLAND, OR 97208

SHELTON, LES
PO BOX 1146
FLAGSTAFF, AZ 86002

**SHEPHERD, ROY F.**
PACIFIC FORESTRY CENTRE
506 WEST BURNSIDE DR
VICTORIA, BC CANADA V8Z 1M5

SHON, FAY
USDA FS FPM
PO BOX 3623
PORTLAND, OR 97208

**SHORE, TERRY L.**
PACIFIC FORESTRY CENTRE
506 WEST BURNSIDE DR
VICTORIA, BC CANADA V8Z 1M5

**SIEBEN, BRIAN**

SINNOTT, MOLLY
NEVADA DIV. OF FORESTRY
885 EASTLAKE BOULEVARD
CARSON CITY, NV 89704

SKYLER, PAT
USDA FOREST SERVICE
2121 C 2ND ST
DAVIS, CA 95616

SLAVECK, STEVE
ABBOT LABORATORIES
AGRICULTURE CHEMICALS
18029 NE 133RD ST
REDMONT, WA 98052

SLOAN, TERRY
AZ STATE LAND DEPT-PRESCOTT
899-C GAIL GARDNER WAY
PRESCOTT, AZ 86301

**SMITH, ERIC**
PAC SW FOR & RANGE EXP STN
1960M ADDISON STREET
BERKELEY, CA 94704

**SMITH, SHERI**

SMITH, TONY
NM DEPT OF AGRICULTURE
PO BOX 6
ALBUQUERQUE, NM 87103

**SOWER, LONNE L.**
USFS FORESTRY SCI LAB
3200 SW JEFFERSON WAY
CORVALLIS OR 97333

SPACE, JAMES C.
10196 RED SPRUCE RD
FAIRFAX, VA 22032-3607

SPAINE, PAULA
USDA FS FSL
CARLTON ST
ATHENS, GA 30602

**SPENCE, JOHN R.**
DEPT OF ENTOMOLOGY
UNIV OF ALBERTA
EDMONTON ALBERTA, CANADA
T6G 2E3

STAGE, ALBERT R.
1221 S MAIN ST
MOSCOW, ID 83843

STARK, R.W.
520 S FIRST
SANDPOINT, ID 83864

STEIN, JOHN D.
PAC SW FOREST & RANGE EXP. ST.
PO BOX 245
BERKELEY, CA 94533

STELTZER, MILT
451 NW HAMLOCK AVB
CORVALLIS, OR 97330

**STEPHEN, FRED**
UNIV OF ARKANSAS
DEPT OF ENTOMOLOGY
FAYETTEVILLE, AR 72701

**STIPE, LARRY**
USFS NORTHERN REGION
PO BOX 7669
MISSOULA, MT 59807

**STOCK, ARTHUR J.**
BC FOREST SERVICE
NELSON REGION
NELSON, BRITISH COLUMBIA,
CANADA

STOCK, MOLLY
UNIVERSITY OF IDAHO
DEPT OF FOREST RESOURCES
MOSCOW, ID 83843

STOSZEK, KAREL
UNIVERSITY OF IDAHO
DEPT OF FOREST RESOURCES
MOSCOW, ID 83843

SU, NAN-YAO
RES 7 ED CENTER
U OF FLORIDA
FT LAUDERDALE, FL 33314

**SUMMERS, DON**
BCFS
3605 192 ST
SURREY, BC
V3S 4N8

SWEENEY, JOHN
FORESTRY CANADA
PO BOX 4000
FREDERICTON, NEW BRUNSWICK
CANADA E3B 5P7

SWETMAN, THOMAS W.
UNIV OF ARIZONA
LAB OF TREE RING RESEARCH
TUSCON, AZ 85721

# WFIWC MAILING LIST

(Conference Attendees in Bold Face)

TALHOUK, SALMA N.
DEPT OF ENTOMOLOGY
UNIV. OF CALIFORNIA, BERKELEY
BERKELEY, CA 94720

TANIMOTO, VICTOR M
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET
HONOLULU, HI 96813

**TAYLOR, STUART**
MINISTRY OF FORESTS
1011 4TH AVENUE
PRINCE GEORGE, BC CANADA
V2L 3H9

TEAL, STEPHEN
ST UNIVERSITY OF NEW YORK
COLLEGE OF ENV SCI & FORESTRY
SYRACUYSE, NY 13210

THIER, RALPH W
USDA FOREST SERVICE FPM
1750 FRONT ST
BOISE, ID 83702

THOENY, WILLIAM T
USFS S FOREST EXP STATION
2500 SHREVEPORT HWY
PINEVILLE, LA 71360

THOMPSON, JACK
USFS NORTHERN REGION
PO BOX 7669
MISSOULA, MT 59807

THOMPSON, LYNNE
UAM
DEPT OF FOREST RESOURCES
MONTICELLO, AZ 71655

THOMSON, ALAN
PACIFIC FORESTRY CENTRE
506 W BURNSIDE DR
VICTORIA, BC CANADA
V8Z 1M5

TISDALEM BOB
MSU DEPT OF ENTOMOLOGY
PO BOX DRAWER EM
MISSISSIPPI STATE, MS 39762

TKACZ, BORYS
COCONINO NATIONAL FOREST
2323 E GREENLAW LANE
FLAGSTAFF, AZ 86004

**TOMLIN, ELIZABETH**
SIMON FRASER UNIVERSITY
DEPT. OF BIOLOGICAL SCIENCES
BURNABY, BC CANADA V5A 1S6

**TORGERSEN, TOROLF R.**
USDA FS FOR. & RANGE SCI LAB
1401 GEKELER LANE
LA GRANDE OR 97850

TROSTLE, GALEN C
7633 NW LOGAN RD
OTIS, OR 97368

TUNNOCK, SCOTT
546 WOODWORTH AVE
MISSOULA, MT 59801

**UPTON, B.**

**VALENTI, MICHAEL A.**
DEPT OF ENTOMOLOGY
WASHINGTON STATE UNIV
PULLMAN WA 99164-6432

**VAN DER MARK, LLOYD**
BCFS
BOX 40
MCBRIDE, BC
CANADA V0J 2E0

**VAN FRANKENHUYZEN, KEES**
GT LAKES FORESTRY CENTRE
PO BOX 490, SAULT STE MARIE
ONTARIO, CANADA P6A 5M7

**VAN SICKLE, G. ALLAN**
PACIFIC FORESTRY CENTRE
506 W BURNSIDE RD
VICTORIA, BC CANADA V8Z 1M5

VANDYGRIFF, JIM
FPM
324 25TH ST
OGDEN, UT 84401

VEBLEN, THOMAS T.
UNIV OF COLORADO, GEOG. DEPT
CAMPUS BOX 260
BOULDER, CO 80309-0260

**VOLNEY, JAN**
NORTHERN FORESTRY CENTRE
5320 122ND ST
EDMONTON ALBERTA, CANADA
T6H 3S5

VRABEL, TOM E.
PHONE-POULENC
BOX 12014, 2T.W. ALEXANDER DR
RESEARCH TRAINGLE PARK, NC
27709

**WAGNER, MICHAEL R**
SCHOOL OF FORESTRY, BOX 4098
NORTHERN ARIZONA UNIVERSITY
FLAGSTAFF, AZ 86011

**WALLNER, W.**
USDA FOREST SERVICE
51 MILL POND RD
HAMDEN CONNETICUT
06514

WALSH, N.J.
MINISTRY OF FORESTS
845 COLUMBIA AVENUE
CASLEGAR, BC CANADA
V1N 3H9

WALSTAD, JACK
FRD COLLEGE OF FORESTRY
OREGON STATE UNIVERSITY
CORVALLIS, OR 97331

WARD, KENNETH
MSU - DEPT OF ENTOMOLOGY
PO DRAWER EM
MISSISSIPPI STATE, MS 39762

**WARDLE, AILEEN**
SIMON FRASER UNIVERSITY
DEPT. OF BIOLOGICAL SCIENCES
BURNABY, BC CANADA V5A 1S6

WARFIELD, TOM
HC 62 BOX 57202
PO BOX 1859
PINETOP, AZ 85935

WARREN, GARY R.
FORESTRY CANADA NFLD/LAB REG
PO BOX 6028
ST JOHNS, NEWFOUNDLAND
CANADA A1C 5X8

**WEATHERBY, JULIE**
USDA FOREST SERVICE, FPM
1750 FRONT ST. RM 202
BOISE, ID 83702

**WEATHERSON, IAIN**

**WEAVER, KEN W.**
BCFS BOUNDARY FD
BOX 2650
GRAND FORKS, BC
CANADA V0H 1H0

**WEBER, J.**

WELDY, WALTER E
BUREAU OF INDIAN AFFAIRS
GLOBE, AZ 85502

**WENZ, JOHN M**
USDA FS STANISLAUS NF
19777 GREENLEY RD
SONORA CA 95370

**WERNER, RICHARD A**
INST OF NORTHERN FORESTRY
308 TANANA DR.
FAIRBANKS, AK 99775-5500

WERNZ, JIM
DEPT OF ENTOMOLOGY
OREGON STATE UNIVERSITY
CORVALLIS OR 97331

WEST, LORNE
PO BOX 577
YOSEMITE, CA 95389

**WHITE, BRAD**
APT.5
4126 12TH AVENUE NE
SEATTLE, WA 98105

WHITE, WILLIAM
USFS FPM/MAG
3825 EAST MULBERRY
FORT COLLINS CO 80524

WHITMAN, THOMAS G
N ARIZONA UNIVERSITY
DEPT OF BIO SCI
FLAGSTAFF, AZ 86011

WHITNEY, H .STU
PACIFIC FORESTRY CENTRE
506 WEST BURNSIDE RD
VICTORIA BC CANADA
V8Z 1M5

WICKMAN, BOYD E.
FOR & RANGE SCIENCES LAB
1401 GEKELER LANE
LA GRANDE, OR 97850

# WFIWC MAILING LIST

(Conference Attendees in Bold Face)

**WIESER, HAL**
DEPT OF CHEMISTRY
UNIVERSITY OF CALGARY
CALGARY ALBERTA CANADA
T2N 1N4

**WIITALA, M.**

**WILLHITE, ELIZABETH A.**
USFS FOREST PEST MANAGEMENT
PO BOX 3623
PORTLAND, OR 97208-3623

WILLIAMS, CARROLL B
DEPT OF FORESTRY & RE MNGT
UNIOVERSITY OF CALIFORNIA
BERKELEY, CA 94720

WILLIAMS, DAVID
PLUM CREEK TIMBER
PO BOX 149
BELGRADE MT 59714

**WILSON, JILL L.**
USFS FOREST PEST MANAGEMENT
2323 E GREENLAW LANE
FLAGSTAFF AZ 86003

**WOLFE, ROBERT L.**
USFS ALASKA REGION, FPM
201 E 9TH AVENUE, SUITE 201
ANCHORAGE, AK 99501

WOOD, ALAN
BOYCE THOMSON INST.
TOWER ROAD
ITHACA, NY 14850

WOOD, DAVID L.
UNIVERSITY OF CALIFORNIA
DEPT OF ENTOMOLOGY
BERKELEY, CA 94720

**WRIGHT, KEN**
22560 SW STAFFORD RD
TUALATIN, OR 97062

**WRIGHT, JIM**
BCFS
BAG 100
SALMON ARM BC
CANADA V1E 4S4

**WRIGHT, DON**
BCFS
BOX 129
100 MILE HOUSE, BC
CANADA V0K 2E0

**WYATT, LYNN A.**
USDA FOREST SERVICE
PO BOX 579
WINTHROP WA P8862

ZHANG,ZHAO YI
N ARIZONA UNIVERSITY
BOX 4098
FLAGSTAFF, AZ 86001

ZIMMER-GROVE, SARA
USDA FOREST SERVICE
BEARLODGE RD PO BOX 84
SUN DANCE, WY 82729